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QUIT BEHAVIOR OF FIRST-TERM
ENLISTED MARINE CORPS PERSONNEL

by

Alvah E. Ingersoll, III

December 1987

Thesis Advisor: Loren M. Solnick
Thesis Advisor: Ronald A. Weitzman

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# Quit Behavior of First-Term Enlisted Marine Corps Personnel

by

Alvah E. Ingersoll, III
Captain, United States Marine Corps
B.A., University of Southern California, 1982

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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December 1987

# ABSTRACT

This thesis examines the effects of personal, human capital, and job-specific characteristics on the quit decision of first-term enlisted Marine Corps personnel. Additionally, factors for census region the Marine enlisted from, the granting of a waiver to enlist, and number of promotions were modeled. The data provided are from the Defense Manpower Data Center Cohort Files and include those who enlisted from September 1980 through September 1981 on a four year contract. A model of utility maximization was used to determine the quit decision. Probit analyses were conducted for the general population and selected groups based on marital status, race, education, and AFQT group. Empirical results of the model indicated, for personal factors, being married and from a minority group significantly reduced quits. The results on census region were generally inconclusive but those from the Pacific and New England area had a higher propensity to quit. The human capital factors supported evidence from previous literature that high school graduates are the "best bet" and less likely to quit. Finally, the job-specific factors for MOS indicate that the two areas with the greatest likelihood of quits were infantrymen and electronic equipment repairman; it was in the overcrowded field of administrative support that the quit rate was large, negative, and significant.

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# I. INTRODUCTION

## A. Background

Because our military system increasingly requires skilled and experienced personnel, the retention of those who have such skills and experience has become a major policy goal. Enlisted personnel who enter the Marine Corps are committed to active duty tours ranging from three to six years. This analysis will focus on those Marines who enlisted in fiscal year 1981, on a four year contract. There are primarily two types of separation that occur, (1) those who decide to quit prior to their initial contract and (2) those who decide to quit at the end of their enlistment. Each of these separations has major policy implications since substantial costs are incurred in recruiting, processing, and training personnel throughout a four-year enlistment. Additionally, there is another and greater cost that can be incurred which is difficult to measure; that is the negative effect that attrition has on overall readiness. Early attrition from the Marine Corps (leaving before fulfilling contract) is primarily a function of substandard behavior of individuals. Since current policies require the discharge of those with substandard behavior, one cannot determine if these individuals wanted to stay in or quit the military. My focus for this study will be on a choice-base model. It is therefore necessary to analyze only those who made the quit decision at the end of their first term of service.

The current trend of increased quits and the inevitability of trying to recruit from a shrinking "qualified military available" (QMA) base are a real potential problem for manpower planners. Today's Marine Corps is an organization that is becoming increasingly technical which in turn requires increasingly skilled and experienced personnel. If the Marine Corps is going to maintain its ability to manage the skill and experience structure of the Corps into the mid-1990's, it will need to know more about the reasons why people quit.

## B. Research Questions

This analysis examines the questions of what demographic, human capital, and job-related factors influence a Marine's decision to leave the Corps at the end of his first term of enlistment. Demographic factors include characteristics such as age, race, sex, marital status, and number of dependents. Human capital factors reflect the amount of time an individual spends in gathering education and training that could have been spent at work. These factors include education, participation in service-oriented youth progrms, such as the Junior Reserve Officer Training Corps (JROTC) and Sea Cadets, and previous work experience. The job-related factors include pay, promotions, military occupational specialty (MOS), and expectations of future salary as related to bonus incentive programs, special pays, and opportunity for promotion.

Two major problems are encountered in attempting to do research in this area. First, due to the wide variety of MOS's, it becomes necessary to group individuals into generalized occupatinal categories. In doing so, it is possible for offsetting factors within the groups to mask the effect a specific MOS may have on the decision to leave, by absorbing part of the variance between itself and the dependent variable. Second, to identify those factors that influence the decision to leave, the statistical models generally require that other factors are held constant while evaluating each factor separately. Models that allow for interactions among the independent variables are complex, and beyond the scope of this research. Additionally, this method accounts for differences in individual attitudes and specific "tastes" for life in the Marine Corps in a limited way. It assumes that these attitudes and tastes are distributed randomly in the sample, and are independent of the explanatory variables.

## C. Scope of Thesis

This study focuses on actual decisions to leave the Marine Corps as measured by personnel records. In analytic terms, I am interested in those factors that contribute to an individual's decision to leave the Marines. The leave decision can best be understood in the context of labor market competition for skills, in which the Marine Corps competes against other services and the civilian sector for necessary personnel. Within this framework, individuals assess the value of compensation and other benefits provided by the Marine Corps, weigh them against civilian opportunities, and act in a manner to maximize their self-benefit. The Marine Corps, on the other hand, has limited resources to induce individuals to remain, and as such acts to minimize its costs in retaining personnel. It is those factors that are subject to policy control by the Marine Corps, Department of the Navy (DoN), and the Department of Defense (DoD), such as military compensation, eligibility requirements, benefits, etc., that I will concentrate upon. It is important to know, for example, whether most of the variance in the decision to leave is associated with compensation, a factor that DoD can directly affect, or whether the leave decision is a result of specific features of the service environment or attitudes individuals hold about the Marine Corps.

There will be two types of analysis done: (1) an aggregate probit model using the 1981 cohort data, and (2) selected subsamples based on demographic characteristics of specific groups. These models will then be tested using the

1982 cohort to determine their ability to correctly predict leavers. The results from each model will be compared to determine if a statistical difference exists between them. The use of OLS, logistic, and Probit functional form will be further discussed in the Methodology Section.

Previous research in this area has focused on those individuals who decided to stay in the military and the factors that influenced them. This approach has its limitations in that estimates produced could be omitted variables, and the limited sample can cause selection bias effects. For example, suppose that I estimate the effect of education level by comparing the quit rates of higher ranked and lower ranked personnel. Even if all other factors are held constant, people who are a higher rank may be different from others. It could be that the quick advancement was a result of a more productive and positive attitude toward the Marine Corps to begin with. Selection bias in this model is impossible to do away with. I attempt to control for this effect by including variables that represent an invididividual's ability.

## D. STUDY ORGANIZATION

The study is organized in the following chapters:

1. Literature Review -Will review and critique previous studies, both civilian and military, in the area of quit behavior. This chapter is organized into

relevant civilian studies by theory and methodology followed by military studies in early attrition and the reenlistment decision.

2. Methodology and Data - I will first describe the data, and discuss the use of Ordinary Least Squares Logit and Probit analysis as modeling techqniues. Second, I will discuss the limitations and differences in the models. Also, I will utilize Pearson Correlation test for multicollinearity and Chi-square test to determine which variables are independently associated with the dependent variable, leave/stay.
3. Analysis and Results - Presentation of the original Probit and selected demographic subsample parameter estimates. Interpretation of results in terms of the relationship between individual characteristics and the dependent variable. Discuss anticipated results of models as related to previous research.
4. Conclusions - A summary of the findings, discussion of the strengths and weaknesses of the study and recommendations for future studies.

# II. LITERATURE REVIEW

Research has shown that quitting behavior can be analyzed through the use of economic theories of utility, specific human capital, job-matching, and job satisfaction. This study focuses on the development of a choice-based econometric model derived through the application of these factors.

In my review of quit behavior literature I found a consistent application of the economic theories of utility maximization, human capital, job matching, and job satisfaction. The basic approach to analysis of this behavior has been to first establish a hypothesis about the quitting behavior of a specific group. Second, is the application of economic theories previously mentioned to generally support the hypothesis. Third, is an explanation of the data and the appropriate sanitation of its inputs. Fourth, is the choosing of specific variables and model building using econometric techniques. Finally, establish a final model, evaluate the empirical results and talk further on specific variables of interest (i.e., their elasticities, significance, and positive or negative effects) and the ability of the model to correctly predict quitting behavior.

First, I will discuss each of the theories as applied to quit behavior. Then I will follow through the above process of analysis of quit behavior by using selected articles.

## A. DEVELOPMENT OF ECONOMIC THEORIES

To understand the effects of human capital, job matching, and job satisfaction theories on quit behavior it is essential to first understand the concept of utility, which is an all encompassing umbrella. In traditional micro-economic theory a "utility is a number that represents the level of satisfaction that a consumer derives from a particular market basket [Ref. 1]". An abstract application of this definition applied to quit behavior would be that a utility is a number that represent satisfaction with a specific job's pay, fringe benefits, social status, and non-pecuniary benefits. To utilize this theory the economist makes three basic assumptions:

1. That an individual has a preference between different jobs and leisure, who can decide and rank in order of importance other alternatives.
2. That the preferences are transitive.
3. That an individual would always act to maximize his utility.

Given these assumptions and that an individual acts in a rational way to maximize his utility, one could then model the quit decision. In modeling this behavior it is reasonable to believe that a person would always want more and more pay, status, or some other characteristics of job satisfaction. However, the law of diminishing marginal utility states, "as a person consumes more and more of a given commodity, ceteris paribus, the marginal utility of the commodity will eventually decline [Ref. 1]." This implies, that at some point, it will take much more of a commodity (for example, pay) to compensate an individual for an additional hour of leisure. This helps explain why an individual earning $500 per 50 hour week, would quit for a job earning $360 per 40 hour week. In essence this individual values his leisure time more than the $1.00 per hour more he could make by working an additional 10 hours per week. This is a simplistic two-dimensional example. However, in real life these tradeoffs are multi-dimensional with many different interacting variables. In the literature reviewed, these variables fall into the following categories: personal characteristics, human captial factors, job specific factors (both matching and satisfaction), and perceptual. The economist then utilizes the specific variables, which proxy for components of utility, to develop a model of the quit decision.

Human capital theory can be thought of a as self-investment, where an individual trades investments he has made in himself (education, training, labor, talent) to a particular firm which has a specific value for that labor. The firm, in turn, pays interest on that labor in the form of wages, further training or education, and certain fringe and non-pecuniary benefits. What this implies is that individuals with certain skills may be of more value to one firm than another and receive different returns on their self-investment. Assuming that an individual has already joined a firm, how does he know when to quit? Whenever the increased returns both pay the initial costs of quitting and yield a rate of return at least as high as alternative investments of one's time he quits. It is important to note that the costs of acquiring human capital occur immediately, so in calculating the costs and benefits (which are received in the future) one must use present value techniques.

Job matching theory looks at quit behavior in terms of job separation based on imperfect information between individual and the firm [Ref. 2, p. 973]. Before developing a model using a job matching approach to turnover there are three assumptions made:

1. A problem exists of optimally assigning workers to job.
2. Employers can contract with workers on an individual basis.
3. That imperfect information exists on both sides of the market (employee vs. employer) about the exact location of ones optimal assignment [Ref. 2, p. 974].

There are two categories into which job matching models fall. First is the learning or experience model. In this model an individual can not fully comprehend the characteristics of the job without "experiencing it." Second is a search model of job separations. In this model the specific job characteristics are known; however, since it is costly to search through alternatives, an individual may take a job without complete information on other job prospects. While working, and as more information becomes available about other opportunities, an individual reappraises his current contract and makes a separation decision.

Within the framework of job matching, previously mentioned, is the question of how job satisfaction affects quiting behavior. These characteristics are captured usually in job specific and non-pecuniary variables. The theory is that dissatisfied workers are more likely to quit than satisfied workers, all other things being equal. These variables deal with compensation, and also use "dummies" to control for specific work type, i.e., laborer, engineer, administrator, etc. Additionally, variables that effect the non-pecuniary aspects of job satisfaction such as status and perceived equality of treatment are included.

## B. CIVILIAN STUDIES FIRM SPECIFIC

A study by Scholl [Ref. 3] selected two large Southern California-based savings and loan associations to evaluate the effect of "career line variables" on turnover and the individuals intent on staying in the firm. The career line can be seen as the number of positions from entry point to ceiling in an organization [Ref. 3, p. 87]. As measures of the individual's intent to remain in the organization, Scholl uses turnover rate, ceiling (highest job attainable in current career path), transit time (time between promotions), position ratio, and mobility opportunity. These variables were then used to calculate an "intent to remain" score. This score was then measured against an "intent to remain scale." Finally, he measures a person's job position and intent to remain, and the total score would reflect the individual's current plans with respect to his future within the organization. The future intent for the individual was derived from a questionnaire given to the employees which identified different degrees of intent to remain from short to long term.

The results of this study support the hypothesis, that career line variables are relevant to the individual's membership decision. A weakness of the study is that it fails to account for other variables affecting organizational commitment. In a sense, the study attempts to do a one-dimensional model correlating turnover with career status. Of the career based variables, a position's mobility had the strongest association with membership. In using this approach he has pre-selected variables affecting "career line" out of his model, such as pay and status. Therefore, this model suffers from variable exclusion, which leads me to believe it is biased.

Parsons [Ref. 4] hypothesized that quit rates and layoff rates are negatively related to the firms' and workers' investments in human capital. Through the application of firm specific human capital theory, Parsons analyzes the quit rates and layoff rates of a broad section of manufacturing industries. He uses cross-sectional data, which is a "snap-shot" of the characteristics of the firms and workers in each industry at the time of the survey.

Under conditions where the firm or the employee makes a large investment in human capital, one would expect reduced quits or layoffs due to the high cost associated with job separation. It also follows that someone who is receiving a higher wage from a specific firm than he could get elsewhere is less likely to quit. From these observations Parsons finds it necessary to divide human capital into worker specific (worker pays to increase personal captial) or firm financed. This is done to delineate between layoff behavior of the firm and quit behavior of the individual.

Next, Parsons develops a theoretical model to determine the firm's optimal choices with regards to quits, layoffs, and wages, given specific market conditions. This firm model is based on profit maximizing, where the wage rate, number of trainees, and layoffs will provide the most experienced worker at least cost [Ref. 4, p. 1123]. Given this assumption, he develops three functions:

1. Worker quit function.
2. Layoff/rehire cycle.
3. Supply of available trainees.

Since the objective of the firm is to maximize profits and get the most experienced for the least cost, it is necessary to take present value calculations of these functions to determine if the employee mix reaches the firm's desired rate of return. Having done this, Parsons then develops a Lagrangian equation and solves for the optimal mix of employees, layoffs, and wages to maximize profits.

$$L = \sum_{t=1}^{2} (P_tQ_t - w_{1t}S_{1t} - w2_tS2_t - ely_t)\delta^{t-1} - \lambda(R_2+D_2-Z_2)$$

t = period

P = production

Q = production function for firm

w = wage

s = supply schedule of trainees

e = cost to firm to separate employee (severance pay, etc.)

ly = layoffs

R = rehires

D = slack variable

Z = past layoffs

δ = rate of return, for present value calculations

λ = lagrangian multiplier

[Ref. 4, p. 1124]

Due to the mathematical sophistication of this model, Parsons used non-linear programming techniques to solve for the maximum condition of L. The derivation of this model is left for the interested reader [Ref. 4, pp. 1125-1126]. There are three critical results developed from this empirical analysis. First, that firm-specific investments reduce layoffs. In cases where direct layoffs cost are high (i.e., high separation pay), the firm will have a reduced incentive to layoff it's employees. Second, the slope of the quit function will affect how the firm will reduce employment, through layoffs or reduced hiring. The slope of this function is dependent on how sensitive the firm is to wage changes. Finally, the shape of the trainee supply function will affect wages and employee mix. If this supply function is wage-elastic, the firm should then attempt to maintain its current labor stock and reduce turnover [Ref. 4].

Parsons next utilizes regression analysis for the quit rate and layoff rate for 47 manufacturing industries. Separate regressions were run for each of the years 1959-1963. The importance of these regressions is that the predicted signs for the variables under the specific human capital theory, matched the signs of the coefficients from the regression. To analyze the quit rate regression model, Parsons used the following variables: wage (median salary), professional (percent employees in professional occupation), rural and south (percentage of employees living in these areas). In the layoff rate regression model he uses wage, education (median years of school), professional, brief tenure (less than six months), capital per man (ratio of value to average employment), 24 or younger (percentage of males 24 or less), white, south, and industry concentration in his model. From all these variables which make up the "test" of specific human capital, only proportion of work force who are professionals did not match the sign predicted using human capital theory. These results allow Parsons to conclude, "that the specific human capital hypothesis for layoff and quit rates is strongly confirmed." [Ref. 4, p. 1138]

In conclusion, Parsons' use of Lagrangian techniques to solve for the firm specific maximum benefit from quits, layoffs, and supply of trainees, solves the problem of separating human capital of the firm's investment and the individual's investment. The following regression analysis then supports the hypothesis of his paper. Finally, I I believe he substantiates that firm specific human captial can be used to determine optimal labor turnover, and type (quits or layoffs) to achieve a maximum desired return for the company be it profit, productivity, or in the case of the military, readiness.

## C. GENDER DIFFERENCES IN QUITS

A study by Blau and Kahn [Ref. 5] attempts to determine if there are any differences in the propensity to quit based on race and sex differences.

In estimating the probability of quitting, Blau and Kahn assume that "individuals seek to maximize their expected discounted lifetime net search cost" [Ref. 5, p. 565]. They consider the future probability of quitting to be a function of the job offer distribution, search costs, the amount of specific human capital, the present value of current job if working, the probability of being layed off, and other characteristics of the current job that makes it attractive" [Ref. 5, p. 566].

Blau and Kahn then use Probit analysis to determine quit probabilities as determined by race and sex. In their results they found that the tenure variable was strongly associated with the probability to quit for all race and sex groups. Also, the variables used for current wage and long term wage were significant and negative [Ref. 5, p. 570, Table 2]. Other variables for education, experience, and marital status were not significant. The only exception to these was for white females whose education was significant at the 5 percent level and positive. Additionally, for white females being married was significant at the 5 percent level and positive. This finding, while not noted by Blau and Kahn, may reflect that white young females actually have a higher propensity to quit because of social norms. Since blacks, and specifically black women, are generally less educated and are more likely to be single parents, their costs of quitting should be higher. In my opinion, this supports the estimation of separate quit functions based not only on sex, but also on race.

Finally, Blau and Kahn take exception to two traditional views. First, arguments that women, and possibly blacks, are less concerned than white males about training and more concerned about current wages [Ref. 5, p. 576]. Their analysis shows this to be incorrect, since the long term wage variable among all race and sex groups is greater than the current gain in wages. This suggest that long-run earnings are important in the considerations of job shifts by youth [Ref. 5, p. 576]. The second argument is that blacks move from one unsatisfactory job to another and do not experience job upgrade. Again, Blau and Kahn's results do not support this, in fact, black males actually had higher short run and long run wage gains by quitting. Blau and Kahn note that this could have resulted from a censoring bias due to the exclusion of those who failed to locate a new job after quitting [Ref. 5, p. 577].

Viscussi [Ref. 6] looks at this same issue of sex difference in worker quitting. His study utilizes the 1975-76 University of Michigan Panel Study of Income Dynamics. He examines the differences in male and female quitting based on economic motivators. These motivators can be characterized as age, race, marital status, and the injury rate percentage of female workers in an industry. Viscussi then looks to see if the data can be pooled (i.e., that the hypothesis that male and female coefficients are identical) [Ref. 6, p. 392]. Through the use of a Chi-square test, he established that there is a difference in the coefficients of male and female quit behavior and, therefore, one can reject the previous hypothesis.

In Viscussi's results he finds that tenure is the most important personal characteristic. He used two variables to evaluate the effect of tenure on quitting. The first tenure variable was a measure of years of experience and the second was "tenurel", a dummy coded 0 for those with less than one year of experience with the firm and 1 otherwise. Viscussi's results showed that for women with less than one year of experience, their probability of quitting was almost twice that of their male counterparts [Ref. 6, p.392, Table 3]. These variables then reflect the elements of job matching and human capital theory on worker quit probabilities. These variables reflect three types of economic impacts:

1. Low tenure workers have less firm specific human capital so that foregone opportunities of changing jobs are less.
2. Greatest period of worker learning occurs during initial period of work.
3. Those with substantial work experience have revealed themselves to be non-quitters [Ref. 6, p. 394].

Viscussi finds that marriage and children are the stabilizing influences for both men and women, Interestingly, "the entire predicted male-female quit difference and half of the actual difference can be explained by differences in job and regional economic conditions" [Ref. 6, p. 397]. Viscussi concluded that the propensity to quit overall is more similar for men and women than originally believed. Finally, he suggests that "if women had the same job characteristics of men their quit rate would be below that for men and their mean quit rate for the sample would be equal to that of men" [Ref. 6, p. 397].

Meitzen's study [Ref. 7] attempts to model male and female quitting models with "duration data on workers spells of employments with firms sampled in the Employment Opportunities Pilot Program (EOPP) Employers Survey." His study is unique in that he utilizes a continuous time hazard model, whereas Viscussi [Ref. 6] and others used discrete time probit or logit models. Specifically, Meitzen uses the Gompertz hazard function to "estimate the probability of worker quits" [Ref. 7, p. 154].

In his results he finds that the tenure variable for males has a significant and negative effect for male quitting. For females, just the opposite occurs, with tenure having a significant positive effect. These are the exact opposite effects that one would expect from a tenure variable. Meitzen concluded that the variables that were to capture specific human capital were unable to do so because a large percentage of the jobs of those in the sample were training slots for more highly skilled jobs. Additionally, since the EOPP looked primarily at workers in their initial employment status, the firm specific human captial investments that keep individuals in a firm had yet to occur.

This suggests, then that the tenure effects "(sign)" is correct for each, but a result of improper job matches rather than human capital investments is responsible for the sign and coefficients of the tenure variable.

With regard to the tenure issue, Meitzen discusses the possible problem of heterogeneity in his sample. Heterogeneity in a sample is when there are unmeasured dissimilarities or inconsistencies in the overall group being tested. For instance, if one wanted to replicate this study for military officers in DoD, and used Army, Air Force, Marines, and Navy in its sample, the tenure variable would possibly reflect not only the effects of length of service, but also inter-service differences of policy that affect tenure. To test for this problem of heterogeneity, Meitzen looks at his model in a reduced form using only the constant term and the tenure variable. His results indicate that the use of the other variables in his model altered the tenure effect. He found that in his reduced form models the tenure effect on males was only slightly more negative, and for females less positive and no longer significant [Ref. 7, p. 159].

In determining the effect of wages on the quit decision Meitzen used an innovative approach. He suggests that people make a quit decision not based so much on their current wage, but their potential "top wage." This would imply that people routinely use present value calculations in their decision to quit. He finds that this variable was statistically significant and negative, on the probability of quitting [Ref. 7, p. 162]. As a result of these findings, he suggests, "that jobs with wage progressions act as a self-selection device by which workers with lower inherent propensities to quit will choose jobs with wage progressions while workers with higher propensities to quit will choose jobs with flat wage profiles" [Ref. 7, p. 163]. From this determination we see that "top wage" effects the quit decision not from the side of present value of future income, but as a result of a specific individual's inherent propensity to quit. This makes the age variable somewhat suspect, because its interpretation is clouded by a self-selection bias of individuals before they enter into firms.

Meitzen found that the probability of quitting for males decreased with tenure while increasing for females [Ref. 7, p. 164]. This leads to the conclusion that job matching process operates differently for females, and further supports the need for estimating separate models for quits.

## D. OTHER CIVILIAN STUDIES

Weiss [Ref. 8] uses utility theory in developing his model for quit behavior. Simply, if an individual's "expected utility from some alternative job offer, or from leisure, exceeds his expected utility on his current job enough to overcome the worker's pecuniary costs of quitting" the worker quits [Ref. 8, pp. 374-375]. To test his model of quit behavior Weiss uses a sample of 2,341 production workers hired in either a southern or midwestern manufacturing plant to do semi-skilled work. Wiess's sample contains only entry level workers on the same wage scale, regardless of age, schooling, previous experience, or job complexity.

The study by Meitzen [Ref. 7] reviewed above indicated that tenure had a strong effect on quits. Also, recall that Meitzen developed separate models for male and female quit behavior. Weiss is unconventional in this aspect, using neither of the previous approaches. Weiss attempts to alleviate the problem of difference in male/female quits with respect to tenure by using only newly hired production workers. Weiss argues that as tenure increases, the wage tenure profile for men and women differ, and that employers believe that women are more likely to quit and, therefore, provide them with less training. As a result, in a sample with men and women over long tenures, one would expect different quit propensities. Weiss hopes that by using these new hires he can eliminate the tenure problem. This study, however, fails to take into account two very critical elements in job selection; first, firm specific human capital brought with new hires to firms, and second, self-selection bias of individuals into jobs with lower wage profiles.

Weiss in his analysis of the data expects three types of factors to affect the probability of a worker quitting:

1. Factors that might be good predictors of alternative opportunities, such as race, education, and where the worker is employed.

2. Factors correlated with satisfaction on the initial job in (1), plus job complexity, the match between worker's job and education level, and a dummy variable to determine whether the worker quit a job to take the job concerned with here.

3. Factors that affect cost of quitting, such as material status, and unobserved characteristics that previously had affected the length of school chosen by an individual. Proxies used were high school graduation and education [Ref. 8, p. 379].

Given these factors are all relevant to the quit decision, Weiss acknowledges that by restricting the study to newly hired workers and holding tenure constant at zero, that correlation between the error terms in the tenure and quit equations is probaby high, the bias is strong (Ref. 9, p. 374). However, Weiss argues that the high wages paid to the workers causes the bias to be small. Weiss does include a variable for previous experience, he does not delineate the types of previous work skills. It seems reasonable, that there would be major problems with job matches between those with previous experience as semi-skilled workers as opposed to those who are not. Those with no experience may have a totally different propensity to quit. This quit then would be due primarily to a job mismatch and not a quit decision based on the individual's utility derived from the job. This is a major problem in his study. It seems more reasonable that to reduce the effect of tenure being correlated with the error structure, one should use an approach eliminating those with short or long amounts of tenure from the sample as done by Solnick [Ref. 9].

Another area of interest, is Weiss's analysis of what affect job complexity has on quits. He finds that assigning workers to more complex jobs does not increase job satisfaction - job complexity is positively correlated with quit propensity [Ref. 8, p. 372]. In semi-skilled labor, more complexity implies greater dexterity and individual concentration (i.e., harder work for the same wage), so it follows that job complexity would be a factor that would affect the quit decision in a positive manner.

Weiss acknowledges the following statistical problems in his study:

1. The use of a Probit estimation procedure relies heavily on the assumption that the error term is normally distributed and homoscedastic (the error term has a constant variance).
2. Assumed education was a function solely of stick-to-itiveness. (More realistically, it is reflective of human capital investment.)
3. The sample suffers from sample selection bias [Ref. 8, p. 383].

Given these limitations, which are to a certain extent a function of available data, Weiss used a Probit analysis of quit probabilities and compared the predictors of his model with conventional "Folk Wisdom." In his results he concludes that:

1. Individuals who drop out of high school, _ceteris paribus_, are approximately twice as likely to quit these jobs.

2. Lower quit rates of workers, employed when the applied for the job being monitored can be explained by differences in worker satisfaction with present job.

3. Workers assigned to more complex jobs are more like to quit than are workers assigned to simpler jobs [Ref. 8, pp. 385-386].

Solnick's study [Ref. 9] of a large manufacturing firm is first unique in the sense that he defines his study group as an internal labor market divided into non-competing entities. It appears that Solnick implicitly assumes a restrictive allocative structure wherein the rules which determine the promotion distribution within the firm are well defined. I believe this is an accurate assumption in that the study also attempts to analyze the effect of promotions on quits within non-competing groups.

Solnick first established the following hypothesis:

1. Absence of promotion, _ceteris parabus_, increases the likelihood of a quit.

2. The more homogeneous the group, the smaller this effect will be [Ref. 9, p. 2].

Next, Solnick establishes as the basis for these hypotheses a model developed on the theory of utility maximization mentioned earlier. To develop variables to determine measures of utility he utilizes proxies such as pay and performance ratings, which individuals use to assess the probability of their eventual promotion.

Solnick developed the following model to estimate the promotion effect on quits:

QUIT = F(personal attributes affecting productivity, job characteristics, family responsibilities, vested pension benefits, personal risk) [Ref. 9, p. 10].

This model contains many of the classification variables previously mentioned. However, Solnick deletes employees with very short or long tenure from his sample. This is done because those who chose not to quit each year have a different average value of risk preference. As a result, the error term in the quit model would be correlated with the tenure variable, resulting in biased parameter estimates. Therefore, by eliminating these employees Solnick is reducing self-selection bias.

In the final phase of the paper Solnick utilizes Logit analysis to estimate the coefficients of the variables selected based on his model. He does this for the entire sample and then breaks it up into three subgroups, defined by their functional area, major field of study, and salary grade. This is done to support the second hypothesis with regards to homogeneity of samples reducing the effect of promotions on quits. This approach did not provide conclusive results as to the overall effect of promotions due to smaller sample sizes.

This raises the question of how did Solnick deal with the problem of heterogeneity in his initial model. Of particular interest would be what effect, if any, did heterogeneity have on performance ratings and variables that proxy the cost of quitting. One might expect that one specific group may be of more value to a firm than another, and as a result, receive inflated performance evaluations as a management tool for retention. Also, the cost of quitting would be different by occupation, as a result of the different amounts of human capital investments. As an example, an engineer's degree may require more of a human capital investment than an accountant. Yet, with uncertainty in the literature with how to deal with the problem of unmeasured heterogeneity, Solnick's approach seems reasonable. In addition, since his variables dealing with human capital (degrees in computer science, accounting, and finance) are strongly significant in his model, one would expect the problem of heterogeneity to have little effect on Solnick's overall conclusion.

Firms trying to satisfy employees but facing increasing direct wage costs, turn to other benefits to try to compensate their labor force. Specifically, certain fringe benefits may act as a deterrent to quitting. Mitchell [Ref. 10] uses a panel data set from the Quality of Employment Survey (QES) conducted by the University of Michigan Research Center. This survey contained individual level data on worker's earnings, job characteristics, human capital, availability of several fringe benefits, and [Ref. 10,

p. 289]. With this data, Mitchell looks at the effect of fringe benefits on job changes. It is reasonable to assume that "Fringe benefits are not usually portable across jobs and are thus described as deterrents to mobility [Ref. 10, p. 282]." In her model the decision to quit is "the difference between total current compensation and that available for an alternative job: $D = C_c - C_a$ . "Therefore, the greater the difference between $C_c$ and $C_a$, the less likely is a job change [Ref. 10, p. 288]."

In her sample Mitchell found that quits accounted for about half of all job changes, the other types of separations included layoffs or discharges [Ref. 10, p. 291]. She then utilizes Probit analysis to examine the effect of fringe benefits on quits and total mobility. Through the application of human capital theory she suggests that higher wages now, should deter quits in the future. In her model the wage effect was significantly negative if she omitted variables accounting for fringe benefits. This led to the conclusion that, "the deterrent effect of wages on quits found in previous studies (for example, Parsons [Ref. 5]) which omit fringes may be overstated [Ref. 10, p. 294].

The empirical results from her study support three main conclusions:

1. Mobility is lower for workers with fringe benefits.
2. Higher wages reduce a worker's quit probability.
3. Quit patterns differ by sex [Ref. 10, p. 291].

Mitchell also points out in her conclusions that fringe benefits were "robust" to the inclusion of other variables. I found this a particularly relevent fact of job satisfaction theory as applied to the military. In the service an individual has an extensive fringe benefit plan and is vested for retirement after twenty years of service. This study supports the idea that lower military compensation as compared to the civilian wage is offset by fringe benefits and should reduce quits. This brings up an important policy question in that should the military or civilian firms increase fringe benefits and not direct compensation to reduce quits?

## E. MILITARY STUDIES OF QUIT BEHAVIOR

Buddin [Ref. 11] analyzes the background characteristics, prior experience, and initial job satisfaction with military assignment of enlistees during their initial transition to military life. The research looks at how these factors affect attrition of male recruits. The analysis is done using the 1979 Survey of Personnel Entering Active Duty and the Services Enlisted Master and Loss Files [Ref. 11, p. 1]. Unlike studies of quit behavior in the civilian economy done by Parsons, Solnick, and others which must delineate job separation in terms of quits, layoffs, or fires, the military separation classification becomes fuzzy due to the unique character of initial long term contracts.

"The premise underlying economic models of job-separation is that the employer or employee anticipates that a separation will enhance his well being [Ref. 11, p. 2]." In the military, however, the member has no "free choice" to quit until the end of his current contract. Therefore, those separated early fall into the category of substandard behavior problems, physical disabilities, and special cases of family emergency. This separation policy makes it difficult to distinguish between quits and fires (those discharged for behavioral problems) because dissatisfied service members have an incentive to induce firing as a last resort to ending their contract.

Buddin applies the theories of specific human capital and job matching theory to analyze enlistment profiles and patterns of early attrition. Using social security numbers Buddin merged the 1979 AFEES survey file with the personnel records from the Defense Manpower Data Center (DMDC) in order to establish a file containing a longitudinal history of individuals in the AFEES survey [Ref. 11, p. 14]. Buddin utilizes a logistic regression model to evaluate the separate effects of individual factors to the overall early attrition level. The use of a least squares regression model was deemed inappropriate because the dependent variables, indicating discharged in the first six months or not, has a Bernoulli distribution (the dependent variable equals 0 or 1) [Ref. 11, Appendix 4, p. 53].

Among his results Buddin found that early attrition rates increase with age in the Army, Navy, and Marines. He found that this age effect was most prominent in the Marines where the early attrition rate of seventeen year olds was 6.0 percent and for nineteen year old was 17.6 percent [Ref. 11, p. 17]. From this result Buddin suggests the possibility that loss rates during the first six months could be reduced by attracting younger recruits. This conclusion lacked insight into the possible affect that, younger enlistees first enter the Delayed Entry Program (DEP) for up to one year before beginning their actual contract. However, their entry age is recorded at the time of contract. So, this initial conclusion is tenuous.

Next, applying job matching theory to recruits, he suggests that those entering with past spells of unemployment or frequent job changes are more likely to separate. Those recruits who are older and fall into this category of frequent unemployment and job separations are referred to as "labor market lemons."

In using participation in the DEP for recruits, there were lower overall early attritions in all services than non-participants. This supports the fact that using age alone as an indicator of success is faulty. However, Buddin believes that "interdependencies among many of the variables may mask the underlying link between any given variable and early attrition in the DEP." [Ref. 11, p. 21].

In conclusion, Buddin compares his multivariate model for military job separations with civilians. The most surprising result was the age factor, with younger recruits less likely to attrite than older recruits. Similarities to other studies exist in that not having a high school diploma almost doubles the possibility of early attrition. Work histories such as previous experience and variables for minority status also had comparable military/civilian effects. Finally, he found that variables measuring job satisfaction had an insignificant effect on determining early attrition.

Bosel and Johnson [Ref. 12] investigate the factors associated with a service member's decision to remain in or leave the military. The data from this study are focused on the separation/retention decision of enlisted members of the four Armed Services at the time of their reenlistment. To address the attrition question Bosel and Johnson adopted a dual approach. First they reviewed existing studies and survey research. This was done to establish corroborating evidence as to what factors affect attrition. Second, they conducted original analysis with information supplied to them by the individual services. The Army provided reports of their 1981 and 1983 omnibus surveys of military personnel along with analysis of its 1983 survey of separating members. The Navy and Air Force provided computer data and documentation from their respective separation and retention survey [Ref. 12, p. 2]. The Marine Corps had no recent data on retention. One should remain suspect of this data, since its validity, reliability, and objectivity is subject to specific service classification policies on separation. It is possible for two individuals to be separated for the same reason but classified differently by their respective service.

Bosel and Johnson take a labor market view of those factors that will affect quitting, "in this process each employee brings to the labor market his or her own package of attributes, which can be understood as combinations of values," [Ref. 12, p. 6]. Each of these given values will result in a positive or negative effect for an individual toward a given job. This package of attributes can be seen as the individual characteristics and attributes which represents the individuals value to the firm. Within this labor market framework Bosel and Johnson attempt to explain why service members stay while others quit, using three explanatory factors:

1. Organizational incentives
2. Individual charactristics
3. Pecuniary and non-pecuniary factors
   [Ref. 12, 10].

Bosel and Johnson evaluate reenlistment and attrition separately. The literature on reenlistment closely parallels the elements of my thesis evaluating quit decisions, and it assumed to be a decision that resides with the service member. While attrition as defined by Bosel and Johnson, has the termination decision as residing with the military [Ref. 12, p. 11]. Therefore, I will focus here on the elements affecting the reenlistment decision, since in my thesis I later plan to develop a choice based model.

Bosel and Johnson begin their analysis of factors that affect the reenlistment decision by looking at pecuniary factors. Within this, they "consider the marginal effects of several different types of service incentives."

1. Base pay and allowances
2. Bonuses
3. Promotions
4. Deferred compensation such as retirement [Ref. 12, p. 12].

Through an extensive literature review Bosel and Johnson conclude that the pecuniary variables are assumed to be the most important and obvious determinents of reenlistment behavior [Ref. 12, p. 20]. Their study looks at studies done by Warner 1981, Chow and Polich 1980, Goldberg and Warner 1982, and others. [Ref. 12, pp. 13-19]

Bosel and Johnson then review research data on the effects of non-pecuniary factors, and find three specific areas of interest:

1. Location and relocation process

2. Job characteristics (defined in terms of functions of their work)

3. Individual characteristics

With respect to the location relocation process, Bosel and Johnson reviewed individual services exit surveys, which generally ask those leaving the service to rank in order the reason why they were leaving. For the Army, being separated from spouse and family ranked third, and for the Navy, first. The Air Force provided a response of a desire for more geographical stability which ranked third [Ref. 12, p. 21]. In addition, I found from the Marine Corps 1986 exit survey, that family separation ranked seventh among reasons to leave. These surveys all indicated that service members are generally dissatisfied with the location/relocation process. From this information one may hypothesize that the location and relocation process plays an important role in the decision to leave the military. However, these surveys are biased in that they are made up of a population that has already exited the services. The fact may be that those that remain in the military are equally dissatisfied with the process, yet stay for other reasons.

It is reasonable to assume that an individual's satisfaction with his work and the characteristics of that work should effect the quit decision. Bosel and Johnson reviewed work done by Penny (1971), Fletcher (1981), and Hiller (1982) [Ref. 12, pp. 25-26]. From these studies Bosel and Johnson were able to reach no strong conclusions. It did appear, however, that job satisfaction played a role in the quit decision.

The next area of concern to Bosel and Johnson was those individual characteristics effecting the reenlistment decision. They focused on traditional variables used in other studies that used measures of education or test scores, sex, race, marital status and number of dependents, and attitudes [Ref. 12, pp. 28-30]. These variables have appeared in studies of quit behavior of individuals in the civilian labor market and have been generally accepted as relevant elements in determining quit behavior.

Finally, Bosel and Johnson use data from the Air Force, Navy, and Army Exit Surveys to estimate retention models. They acknowledge the weaknesses of these data as a low response rate in the exit survey, and that the respondents are only those leaving the services. Thus, these data cannot shed light on factors to distinguish leavers from stayers [Ref. 12, p. 35]. From the models estimated (apparently OLS but not specified) Bosel and Johnson reach the following conclusion on individual characteristic variables:

1. Education and Test Scores - Evident that those who have related deficits in education and test levels are more likely to attrite [Ref. 12, p. 57].
2. Age - That there is no reason to believe that a rela-relative lack of maturity is a cause of attrition [Ref. 12, p. 59].
3. Marital Status and Dependents - Data concerning these effects were inconsistent [Ref. 12, p. 59].

4. Attitudes - Strong association between attrition and previous behavorial problems [Ref. 12, p. 60].

Blandin [Ref. 13] studies non-high school graduates (NHSG), non-prior service (NPS) males who entered the Army in Fiscal Years 1974 to 1976. These data were chosen for two principle reasons:

1. FY-74 group represented first full year of All-Volunteer Force (AVF) experience and as such there were no draftees.
2. There were reasonable enlistment attrition statistics for those individuals who enlisted in 1976 [Ref. 13, p. 5].

Blandin's research focuses on two related views:

1. Trying to identify predictors that are associated with individual success in completing one full enlisted tour.
2. Recruiting from labor market segments which historically have not been heavily recruited. As an example the increased substitution of women for men in selected MOSs [Ref. 13, p.2].

Since historically the attrition rate for NHSG-NPS individuals is higher than for those with high school degrees, Blandin attempts to develop a predictive model that would allow for the identification of low attrition risk people from the NHSG-NPS group. In selecting variables for his model Blandin uses a Chi-square analysis to determine which variables were independently associated with the dependent variable attrition [Ref. 13, p. 6]. From this analysis Blandin selected variables based on an individual's race, highest year of education completed, month entered the Army, age, census region, and Armed Forces Qualification Test Group Score (AFQT).

Blandin next decided to group the data in his sample due to the large number of observations (180,000) and to reduce computational expense [Ref. 13, p. 8]. Having decided this, Blandin then decides to estimate both a linear regression model and a logistic regression model. However, since his dependent variable is attrition/non-attrition, a 0 or 1 variable, there is a probability that the predicted value may fall out of this range. In cases such as this, the logistic model is preferred on the theoretical grounds that the underlying function is not linear. Blandin argues that "the ultimate choice between the two (logistic or linear) depends on how well each represents the data to which they are fitted [Ref. 13, p. 10]."

Another problem that Blandin encounters is that by grouping his data there may exist heteroscedasticity. This could then effect the model's ability to estimate the parameters of the selected variables. Blandin counters this effect by transforming the data so that the error term has a constant variance [Ref. 13, p. 10].

The results in the linear model led to four general conclusions:

1. Years of education even among NHS population are positively and significantly associated with the probability of staying.

2. Age is associated with attrition (the older, the less the probability of attriting).

3. Census regions are associated with attrition.

4. Higher AFQT standing, the less the probability of quitting [Ref. 13, pp. 11-14].

The result that age was a positive and significant variable contradicts findings made by Buddin [Ref. 1]. Buddin had found that older recruits would have a higher probability of leaving. I believe what Blandin has found more specifically by using only NHSG-NPS in his sample, is that the job matching theory and classificaiton of older individuals as "labor market lemons" does not apply. This result is suspect, however, since there is no variable in his model to account for previous work experience or unemployment encountered by individuals in the civilian labor market. The results that increased education and AFQT group reduce the probability is consistent with other studies of quit behavior.

The logistic model yielded results that were consistent with the linear model in terms of the relationship between the independent variables and attrition, leading to the same general conclusions as above.

Finally, Blandin uses the 1976 Fiscal Year cohort to test the predictive ability and compare the results for each model. The individuals in this cohort were first evaluated as to the likelihood of their non-attrition and then ranked into groups ranging from the top 1,000, 1,000-2,000, 2,000-5,000, and so on. The results from both models were essentially identical when tested.

Blandin provides three conclusions from the empirical results of his study:

1. Individuals with different attribute profiles also differ with respect to their probability of quitting.
2. On a relative basis, "good bets" from "poor bets" can be differentiated.
3. Both models do a slightly better overall prediction job, compared to either education or AFQT group as a selection criteria [Ref. 13, p. 20].

Elster and Flyer [Ref. 14] studied Non-Prior Service (NPS) enlisted personnel to determine loss probabilities given selected entry factors. The population studied consisted of all non-prior service accessions entering active service during Fiscal Year 1973 through 1978 [Ref. 14, p. 14]. The data was provided from the DMDC cohort files and included accession records and personnel inventory loss files. The entry variables used were service, sex, race, education level, age, marital status, AFQT group, and area of residence prior to enlistment. The attrition rates were first estimated for each service and DoD overall for the first three years of service. Elster and Flyer's objective is to provide information on loss probabilities that may be used as a screen by recruiters to reduce the high cost of attrition.

Elster and Flyer's results confirm those made by the Comptroller General in his February 1980 report to Congress.

They found that of attrition occurring in the first three years of service, about half takes place in the first twelve months [Ref. 14, Table 3, p. 18]. The reasons for separation are also a result of a reenlistee's inability to meet the behavorial or performance standards of the military [Ref. 14, Table 4, p. 19]. Next, Elster and Flyer develop a comprehensive set of tables accounting for attrition by race, education level, marital status, age, and AFQT group. Following are some Marine Corps specific items of interest. For a more comprehensive review the interested reader should review the work with emphasis on the tables on pages 17-66.

For the Marine Corps they found that black enlistees have about a ten percent higher attrition rate than non-blacks [Ref. 14, p. 26]. This race variable I would also anticipate to effect the quit decision at the end of service if there exists an inequality of treatment by race. Given the previous evidence that blacks have a higher attrition rate, it is not surprising to find that blacks have also a higher attrition rate than non-blacks for performance/ behavior problems [Ref. 14, p. 28]. Part of this race effect, I believe, may be accounted for by endemic characteristics of the data collection period. During the early to mid-seventies in the Marine Corps as well as other services, racial discord was a common occurrence. However, I believe that through extensive programs and education, all services had reduced this race effect, by the early 1980's.

Therefore, some of these loss probabilities are now suspect and should be reworked from data starting after 1980.

Among the results for attrition rates by education level, AFQT category, and race, blacks had a generally higher attrition rate. However, after controlling for education level and AFQT group, the difference in attrition rates was small in every service except the Marine Corps [Ref. 14, 34]. This result also suggests some external factors as effecting the results.

Attrition rates by marital status show that both male and female recruits who are married at the time of their enlistment are more likely to attrite than those who are single [Ref. 14, p. 43]. For all services this effect was most pronounced for Marine Corps recruits and most probably a result of the expeditionary nature of the Marine Corps, and frequent moves and demands placed on the new recruit.

Elster and Flyer's results on the effect of age on attrition were interesting, and supported those found by Buddin [Ref. 11]. For males and females, seventeen year olds had higher attrition rates than eighteen or nineteen year olds. Yet high attrition rates are generally experienced by older male enlistees [Ref. 14, p. 67]. This supports Buddin's findings, and is in line with job matching theory that older recruits are enlisting as a means of last resort, and resulting from failure in the civilian labor market.

When recruits were grouped by their home state at time of enlistement, attrition rates would vary by racial group and sex. The general finding was that within racial or gender groups, states with higher attrition rates are generally the same for men and women and for high school graduates and non-graduates [Ref. 14, p. 68].

From the extensive statistical analysis done, Elster and Flyer conclude, "that the prediction of attrition from individual information can be improved significantly by taking into account interactions among such factors as service, sex, race, education level, age, marital status, AFQT group, and home area of enlistment." [Ref. 14, p. 69].

In an annex to this report Elster and Flyer test to see if there is a relationship between the Delayed Entry Program (DEP) and attrition. The DEP is a recruiting management tool utilized by the services to get new recruits enlisted in the specialty of their choice, primarily a school timing issue. This analysis looked at total time spent in DEP and failed to take into account specific specialties individual's would be trained for. This would be important in the event an individual's potential skill became available in the civilian market while waiting in the DEP. "The differences in attrition rates by time in DEP are very large for male recruits, and appear to tap motivational and other factors not well measured by other enlistment information [Ref. 5, p. 74]." Therefore, Elster and Flyer conclude that this element should be included in any composite score used to predict attrition of an entry group [Ref. 14, p. 74].

Lang's [Ref. 15] study looks at the Marine Corps accession policy for granting waivers to recruit applicants who fail to meet enlistment standards. The problem as stated realizes that from 1978 to 1984 there has been a steady increase in the number of waivers granted [Ref. 15, p. vii]. An objective of this thesis is to determine what impact the granting of waivers may have down the line, and if any correlation exists between those granted waivers and those who separate at the end of their enlistment.

Waiver Classifications in the Marine Corps can be placed into the following categories:

1. Age
2. Number of dependents
3. Mental qualification (as determined by AFQT category)
4. Physical qualifications
5. U.S. citizenship
6. Education
7. Moral qualification.

The "moral qualification" category includes both criminal and non-criminal offenses [Ref. 15, p. 1].

The methodological approach to this study was to compute the number and type of waivers granted during each fiscal year and try to establish if any trend exists. The empirical results of the analysis indicated that the primary increase in waivers was due to an increase in minor traffic violations [Ref. 15, Table 4, p. 2]. An individual who receives six traffic tickets needs a waiver to enter. Given this number, the report concludes that the increase in waivers may be a function of increased police enforcement, or computerization and better reporting systems.

Next, the study tries to isolate if the effect of granting a waiver will increase the probability that an individual will be separated early from the Marine Corps. This is done by comparing those with no waivers who separated early to those with waivers who separated early. The results indicated that for those granted waivers for minor traffic violations, no difference existed; but, for other moral waivers there was a difference [Ref. 15, Tables 5 and 6, p. 5].

May's [Ref. 16] research estimates the cost that the Marine Corps incurs when first-term enlisted personnel leave the service. The expected cost of attrition is calculated for several personnel categories that are defined according to levels of education and ability [Ref. 16, p. iii]. The rates of attrition used in this study were calculated from the Headquarters Marine Corps Enlisted Master File.

May defines the cost of attrition to be equal to all expenses of replacing an individual minus any investment recouping that may be made by keeping initial wages low [Ref. 16, p. 1]. Next, May divides the enlistment period into the following categories: Delayed Entry Program (DEP), Boot Camp Training, Initial Skill Training, and remaining enlistment. These all appear to be reasonable breaks in the first enlistment and each has unique characteristics making one anticipate different probable attrition rates in each phase.

DEP attrition occurs between the period an individual signs an enlistment contract with the Marine Corps but is placed in a waiting pool, until actually being "shipped" off to start his active service. May found that attrition from the DEP varies across personnel types, and that attrition does not appear to be highly correlated with education level [Ref. 16, p. 7]. Next, controlling for both education and ability, revealed that the DEP attrition level did not vary across ability levels within specific education groups [Ref. 16, p. 11].

To determine total cost of DEP attrition May assumes that recruiting is made up primarily of variable cost. The costs for advertising, enlistment bonuses, and recruiter training are all treated as fixed costs. Therefore, if one wants to determine the costs of recruiting an individual they would have to know the time spent by the recruiter and the quality of recruit. Since the cost of recruiting a high quality or low quality person is not directly known, May estimated the cost by using an enlistment-supply equation for high and low quality recruits [Ref. 16, p.12]. The total expected cost of DEP attrition was estimated to be the marginal cost of recruiting, times the attrition rate. Previously, May had stated that attrition rates varied across personnel types, by education and ability. To account for this the final DEP cost equations were then divided and estimated separately by quality of recruit, education, and ability [Ref. 16, p. 14].

Most of the attrition that occurs happens within the first twelve months of service (Elster and Flyer [Ref. 5]), and of that, most occurs during Boot Camp [Ref. 16, p. 15]. The attrition rate was found to be lower for high school graduates than for those with GED's or non-graduates. However, May found no distinct pattern in the variation of attrition levels across ability groups [Ref. 16, p. 16]. The cost to the Marine Corps for a Boot Camp attrition is then equal to the cost to recruit and train a replacement up to the point where that individual separated. (The estimated 1985 cost of an individual who completes boot camp is $5,404.00 [Ref. 10, Appendix C]). The average time in boot camp before attrition was calculated to be 48 percent of completion of the course. Therefore, the Marine Corps spends .48 x 5404 = $2,637.00 to train and replace, to the level of the average individual who leaves [Ref. 16, p. 16].

Initial skill training length is dependent upon an individual MOS. It can vary from six weeks of infantry training to two years for aviation electronic technicians. The average time in initial training schools is approximately 83 days. May found that attrition from initial skill training is generally low, and occurs approximately one-third of the way through training [Ref. 16, p. 17]. May, also found that attrition did increase as an individual's ability level went down. To calculate the attrition costs from initial skill training May takes one-third of the average initial training cost and adds boot camp costs to come up with $7,320.00 to replace an individual who attrites from initial skill training [Ref. 16, p. 18]. I found this somewhat suspect, because May failed to identify if those who attrite from one initial skill were sent to another, thereby saving the boot camp cost. This calculation is also questionable, because the Marine Corps rarely separates individuals on the grounds of failing initial skill training. Additionally, an initial skill training attrition does not necessarily equal a service attrition, and this distinction is not brought out in May's research.

Finally, attrition during the remainder of the first term enlistment was found to vary significantly across educational level and ability [Ref. 16, p. 19]. Since post training attrition is more difficult to predict, a cost equation would need to reflect the recouped cost the Marine Corps has made. However, since one cannot easily measure the economic output, the degree of investment recouping is difficult to distinguish. Therefore, May assumes that the Marine Corps recoups its investment evenly over the post-period training [Ref. 16, p. 22]. Using average individual post-training attrition May estimates the cost to replace the individual to be $11,686.00 in 1985 dollars.

In conclusion, the cost of attrition is dependent on quality of recruits desired and the timing of their separation. In 1985, attrition costs for the Marine Corps were estimated to be from $2,194.00 to $6,908.00 per contract. Since the Marine Corps recruits 40,000 people a year, the annual cost of attrition is in excess of $87 million dollars [Ref. 16, p. 24].

Chow and Polich [Ref. 17] use the 1976 DoD personnel survey in developing and measuring factors in the reenlistment decision. In developing a framework for their analysis, they attempt to estimate reenlistment based on personal characteristics, and policy relevant variables. The decision to reenlist is viewed basically as a supply side question, where the decision to stay or leave is voluntary. However, Chow and Polich astutely recognize that there exists some distortion in the data because demand side factors affect some peoples decision to reenlist. As a result of constraints on individuals, be they based on rank, occupational specialty, or lack of recommendation from a commander, they were barred from reenlistment. It is difficult to capture the leave/stay decision by looking at inter-service separation codes because many times an individual advised that he will not be able to stay, simply does not attempt to reenlist and is, therefore, classified the same as someone who decided not to reenlist. To make this distinction requires the use of reenlistment codes given to individuals on separation, this was not available to Chow and Polich in their data. To omit people who would have been most subject to ineligibility for reenlistment, Chow and Polich exclude those who have not reached at least paygrade E-4 [Ref. 17, p. 6].

Chow and Polich concentrate on measuring factors that affect the reenlistment decision, which are subject to control by the DoD, such as military compensation and the work environment. The value of military compensation is a factor that is greatly misunderstood by the enlisted force, but repeatedly throughout studies appears as a major factor in the reenlistment decision. To understand how the charcteristics of military pay affect reenlistments, Chow and Polich examine pay in four aspects:

1. Precise measure of real military income (RMC) based on pay grade, years of service, and dependency status.
2. Measure of RMC including a method to distinguish the effects of pay given in cash, versus pay given in kind benefits.
3. Construction of a variable representing people's perceptions of the value of their RMC, as opposed to actual value.
4. A measure of the reenlistment bonus available to each member of the sample [Ref. 17, p. 14].

In using the "precise measure" of RMC, Chow and Polich calculate the actual cash income to the individual to include allowances for housing and subsistance. However, in the junior enlisted grades there is normally no actual cash outlay, but the benefits are given out "in kind" such as mess hall facilities and barracks. There is no choice for a single individual in his first term, he must take in kind benefits. Given that the population of first term enlistees is primarily single, I question the validity of including these elements as a precise measure of RMC. This point is a major contention among junior enlistees who would prefer the cash benefit so they could decide on the quality mix of goods that give them the highest benefit. So strictly speaking, this factor fails to capture RCM as a precise measure for the majority of those in the data base.

The "perceived" cash value of RMC was found to be undervalued by those in the service [Ref. 17, p. 17]. Chow and Polich propose several reasons to explain this effect:

1. The complexitry of the pay system, including in kind payments and invisible tax advantage.
2. Most income surveys find people underreport their income, so not surprising for military.
3. A measure of the reenlistment bonus available to each member of the sample [Ref. 17, p. 14].

The military's use of reenlistment bonuses is a recent compensation tool used to manage manpower levels with a specific interest on MOS fields with a critical shortage.

The bonus programs offer a cash amount equal to a "multiple" for a specific occupational specialty, times one months base pay, times the number of years reenlisted. Chow and Polich do not use the total cash amount received to represent the bonus, but rather decide to represent the potential bonus per year [Ref. 17, p. 20].

Having developed factors that account for wage effects for their model, Chow and Polich next select indicators of civilian earnings opportunities, the service environment, and attitudes about the military to complete their model.

The variables representing civilian opportunities include demographic measures seen in previous studies, i.e., education, race, sex, AFQT group, and MOS. To evaluate the service environment, Chow and Polich looked at aspects of location, inside or outside of the U.S., time spent at work, and imbalance (overcrowding) within a specialty. To estimate attitudes toward the military Chow and Polich attempted to find to what degree of volunteerism did those in the sample originally enlist. This effect was due primarily to many "draft induced" volunteers in the data base of the mid-seventies. An interesting current measure in today's All-Volunteer Force may be to determine to what extent individuals are "economic conscripts" as a result of the high percentage of minority representation in the services.

In estimating the parameters for the reenlistment model, Chow and Polich used a method known as the discriminant function technique [Ref. 17, p. 27]. The regression results from the analysis are as follows. Those who perceived larger values of RMC are more likely to reenlist. A higher tendency to reenlist was found among those living in military housing with dependents than others. That the demographic variables of sex, education, race, and mental ability appear to measure the potential of getting a desirable civilian job. Finally, that the affect of a bonus was smaller than the affect for the same wage increase in RMC [Ref. 17, pp. 28-33].

Warner and Goldberg's [Ref. 18] study on non-pecuniary factors influencing the reenlistment decision of Navy personnel categorized Navy occupational specialties into 16 groups and tried to estimate the elasticity of labor supply for each. One of the major factors affecting the reenlistment decision in the Navy is sea duty. A 1987 Navy Times release indicated the results of Navy exit surveys among enlisted personnel which rated "sea duty and family separation" as the number one reason for their decision to leave. Warner and Goldberg formulate an economic model of the reenlistment decision, based on the theory of utility maximization which attempts to annualize the cost of leaving the service for an individual. This annualized cost of leaving (ACOL) model is unique in that it takes into account not only demographic and compensation factors, but also includes a "taste" factor to measure preferrability of military to civilian life [Ref. 18, p. 27].

Warner and Goldberg assume that the reenlistment supply function is normally distributed with mean $\mu$ and variance $\sigma^2$. They note that, "the supply curve becomes more elastic as the variance of the difference between military and civilian taste factor decreases, and that the elasticity of supply reaches infinity under two conditions:

> 1. When military and civilian taste factors between individuals become more similar and when the variance approaches zero.
>
> 2. When military and civilian taste factors are highly correlated and become perfect substitutes for one another. [Ref. 18, p. 28]

Under the first condition occupational supply curves become more elastic the less the dispersion in taste across individuals. Under the second condition, civilian and military employment are viewed as close substitutes for one another and the elasticity of supply will be high. [Ref. 18, p. 28].

The data for this study was taken from the FY-1974 to FY-1978 DMDC files on all Navy personnel who made a reenlistment decision. Next, the personnel in the data were divided into 16 occupational groups. To test the theory on the effects of non-pecuniary elements, Warner and Goldberg estimated probit reenlistment equations for each specialty [Ref. 18, p. 29]. The empirical analysis showed probit results for specification of the model that included

ACOL calculated over the horizon of a 4-year reenlistment [Ref. 14, Table 2, p. 32].

From the result of the analysis Warner and Goldberg reach two conclusions:

1. That the variation in ACOL explains much of the variation in the probability of reenlisting.
2. That the estimates for the coefficient for sea duty varies with the extent of sea duty [Ref. 18, p. 32].

Additionally, the results showed that married individuals reenlist at a higher rate than single persons. Also, the variable accounting for civilian unemployment was only positive and significant in about half of the estimated equations by specific occupation.

Finally, Warner and Goldberg suggest that sea duty serves to shift the supply curve for Navy personnel as well as alter its slope [Ref. 18, p. 33]. To test this, they estimated a probit equation across all of the personnel making the reenlistment decision in FY-1979. The results indicated that the sea duty variable has a highly significant negative effect on first-term reenlistment rates [Ref. 18, p. 33]. In conclusion, this study developed and estimated a model for first-term reenlistment in the Navy. Its results suggest that manpower planners should focus on the effect that sea duty has on reenlistments.

Lakhani and Gilroy [Ref. 19] attempt to isolate those factors that determine the reenlistment/extension/separation decision. Particular attention is paid to military pay, and the selective reenlistment bonus (SRB) of specific military occupational specialties (MOS). In focusing on compensation, Lakhani and Gilroy first develop a civilian wage model to estimate the potential earnings of personnel leaving the Army. This model uses variables similar to those used in previous studies; specifically, wage, unemployment, education, experience, race, marital status, and number of dependents. The data used in estimating the model came from a 1981 National Longitudinal Surveys (NLS) of Young Labor Market Experience [Ref. 19, p. 227]. Lakhani and Gilroy failed to select a sex specific variable, and, therefore, must implicitly assume that the wage earning profiles and reenlistment behavior of men and women are the same. In studies by Weiss, Viscussi, and others, a reasonable basis has been established to estimate separate models of quit behavior based on sex. Therefore, eliminating this sex variable may bias the sample due to the different cost associated with leaving. Lakhani and Gilroy then use a log-linear regression to estimate the coefficients for the civilian wage model and use the results to predict the implicit civilian wage first-term Army enlistees would face [Ref. 19, p. 227].

The first-term enlistee also has three discrete choices at the end of his first enlistment: (1) separate, (2) short term commitment or extension, and (3) long term commitment. Within this context Lakhani and Gilroy develop a model based on the theory of utility maximization [Ref. 19, p. 229]. Their utility model consisted of two parts: "(1) the systemic or representative and deterministic part that can be easily measured and (2) an unobserved random or stochastic part [Ref. 19, p. 229]." Given this model, a rational service member would choose the reenlistment option that maximizes his utility.

The data for estimating the reenlistment model were taken from the Army Enlisted Master File for FY-1980 and FY-1981. The MOSs were grouped into 15 career management fields (CMF), each group as homogeneous as possible. The military wage an individual received was calculated as base pay plus allowances for quarters, subsistence, and variable housing. Unemployment rates were obtained from the Bureau of Labor and Statistics (BLS) [Ref. 19, p. 232].

Lakhani and Gilroy proceed to estimate a multinomial logit reenlistment/extension/separation equation for each of the 15 CMF's and a total among all CMF's. Among the results it was found that the coefficient for SRB's was positive in all equations. The coefficient for wage was positive in all but three of the CMF's. The coefficient for race was also positive and significant in all 15 equations with blacks reenlisting at a greater rate than their white counterparts [Ref. 19, p. 237]; indicating perhaps that there is less discrimination and better opportunities for blacks in the Army.

The only results that Lakhani and Gilroy did not anticipate were for unemployment and AFQT scores. They explain that the effect of unemployment is also captured by the civilian wage variable, so that collinearity among these variables may have masked the unemployment effect [Ref. 19, p. 237]. In terms of the AFQT variable, they were unable to explain the positive sign and were continuing work to correct or explain this counterintuitive result [Ref. 19, p. 240].

Finally, retention was shown to depend on both regular compensation and SRB's. Therefore, force managers can manipulate bonuses and special pay so as to reduce payments to those military occupations where civilian demand is less, and increase it where demand is high. In conclusion, Lakhani and Gilroy's findings suggest that Army manpower planners should rely more heavily on economic incentives to obtain specific types of labor.

## F. CONCLUSIONS

These readings on quit behavior focus on the application of economic theory to particular sections of society based on gender, specific firms, and military service. A major difficulty encountered in the research was how to determine which variables can best act as predictors of quit behavior. The problem, along with a lack of available data which measures performance, promotability, and other non-pecuniary variables, required researchers to use innovative modeling techniques that best take into account non-pecuniary factors through the use of proxy variables. Generally, the variables chosen to model quit behavior can be categorized into one of the following groups: (1) pesonal characteristics, (2) human capital factors, (3) job-specific variables, and (4) non-pecuniary factors.

The studies which reviewed quit behavior as a function of gender substantiate that different models for quits should be estimated based on sex. Given this result, I have chosen to estimate a model for male enlistees only.

The remainder of studies which involve quits in civilian firms, early military attrition, and reenlistment behavior all provide important insights, to which factors had previously been significant in determining quit behavior. The economic theories used and models specified were well defined and best estimates given the available data. These studies, and the techniques utilized, are acknowledged as a foundation for the variable selection and model specification for this thesis.

# III. DATA AND METHODOLOGY

This section will discuss the selected sample's composition, and describe the underlying data set. Additionally, it will describe the criteria for model selection along with the estimation techniques used in the final model specification.

## A. DATA ORGANIZATION

The data used in this sample are extracted from the Defense Manpower Data Center (DMDC) cohort files and include Marine Corps non-prior service males who enlisted between September of 1980-1981 on a four year contract. These data elements were obtained by matching the most recent information from the Headquarters Marine Corps enlisted master file (EMF), with the cohorts master or loss records, with the most current record taking precedent.

Within this data set are Inter-Service Separation Codes, which classify under what conditions an individual is separated. These separations can be narrowed down into nine general areas: (1) Release from service - end of contract, early discharge program, (2) medical disqualifications, (3) dependency or hardship, (4) death, (5) entry into officer programs, (6) retirement, (7) failure to meet minimum behavioral or performance criteria, (8) others, and (9) reenlistment. For this study I am interested only in those individuals who voluntarily made the decision to quit the military or reenlist. All other separations were those over which the individual had little or nor control. Therefore, under this criteria, only those in categories (1) and (9) were selected for the sample.

Additionally, I selected only those in paygrades E-3 through E-6. I imposed this condition because it would be impossible for an individual to be a paygrade E-2 without having received some type of disciplinary action in his first term of service, thus his quit or stay decision would become a function of command waivers for reenlistment, again an condition over which the individual has little control.

After selecting the sample according to the criteria above my data base consisted fo 12,801 cases. Among these 9,711 (75.9 percent) had made the decision to quit, and 3,090 (24.1 percent) to reenlist. It is important to note that this data base accounts for only those who made an immediate reenlistment decision on expiration of their contract. Those who separate, but reenlist at some point in the future are considered "quitters" in this study. Also, I am aware that some individuals may wish to reenlist, but due to MOS constraints imposed by Headquarters Marine Corps requiring lateral moves may not do so. Additionally, constraints such as rank requirements, education level, or commander's recommendation can effect the individual's leave/stay decision. These type of criteria are a result of demand for the composition of the upper ranks of the enlisted force. Given these demand side constraints exist, it is possible that they may distort the true voluntary nature under which the decision to leave or stay is based. However, given available data it is not possible to isolate such effects. Generally, the number of cases effected by demand side constraints is considered to be small and should, therefore, have no effect on my final model specification.

## B. DATA ELEMENT DESCRIPTION

Within the data set there exists several categories that variables may be grouped in. The areas are selected from previous studies such as Solnick, [Ref. 9], Blandin [Ref. 12], and Chow and Polich [Ref. 17], and establish a basis for variable selection in the model specification. Specifically, for this study I have grouped them into three categories: (1) personal characteristics, (2) human capital factors, and (3) job specific factors. For a complete listing see Table 1.

(1) Personal Characteristics - These variables include marital status, number of dependents, race, and geographical region of enlistment. A set of eight dummy variables indicate the region of enlistment. See Table 1. East North Central is the omitted group.

(2) Human Capital Factors - These include education level, experience in a Junior Reserve Officer Training Corps or Sea Cadet program, Armed Forces Qualification Test Group (AFQT), and other specific section of the Armed Services Vocational Aptitude Battery (ASVAB). Education level included a set of three dummy variables with high school graduates as the omitted group. The AFQT group consisted of three dummies, those in categories I through IIIB. The omitted group was mental categories IVA, IVB, and V. The AFQT score is a composite of three test sections out of nine from the Armed Forces Vocational Aptitude Battery (ASVAB). (AFQT = Arithmetic Reasoning + Verbal + Numeric Operations/2.) Other dummy variables created using the ASVAB score were general science, word knowledge, math knowledge, mechanical comprehension, and electronic information.

(3) Job Specific Factors - This set of variables set out to capture the effects of paygrade, an initial enlistment waiver, specific MOS groupings, timing of entry, and promotions. The use of the waiver variable is to determine, using two dummy variables, first those who received waivers for "moral" disqualifications, (i.e., excessive speeding tickets, misdemeanor arrests, or experimental drug use) and, second, those who received "other" waivers (i.e.,

## TABLE 1

## EXPLANATORY VARIABLES

### Personal Characteristics

| | | | |
|---|---|---|---|
| 1. | Marital Status | 1 = Married | 0 = Single |
| 2. | Number of Dependents | Continuous | 0 - 6 |
| 3. | Age at End of Contract | Continuous | Variable |
| 4. | Black | 1 = If applicable | Else = 0 |
| 5. | Other Race (Asian,Indian Alaskan) | 1 = If applicable | Else = 0 |
| 6. | Enlisted in Mid-Atlantic Region | 1 = If applicable | Else = 0 |
| 7. | Enlisted in West/North/Cent. | 1 = If applicable | Else = 0 |
| 8. | Enlisted in South Atlantic | 1 = If applicable | Else = 0 |
| 9. | Enlisted in East/South/Cent. | 1 = If applicable | Else = 0 |
| 10. | Enlisted in West/South/Cent. | 1 = If applicable | Else = 0 |
| 11. | Enlisted in Mountain Region | 1 = If applicable | Else = 0 |
| 12. | Enlisted in Pacific Region | 1 = If applicable | Else = 0 |
| 13. | Enlisted in New England | 1 = If applicable | Else = 0 |

### Human Capital Factors

| | | | |
|---|---|---|---|
| 14. | Non-High School Graduate | 1 = If applicable | Else = 0 |
| 15. | Some College Education | 1 = If applicable | Else = 0 |
| 16. | College Degree | 1 = If applicable | Else = 0 |
| 17. | Junior ROTC Experience | 1 = If applicable | Else = 0 |
| 18. | AFQT Group I | 1 = If applicable | Else = 0 |
| 19. | AFQT Group II | 1 = If applicable | Else = 0 |
| 20. | AFQT Group IIIA & IIIB | 1 = If applicable | Else = 0 |
| 21. | ASVAB General Science Score | Continuous | Variable |
| 22. | ASVAB Word Knowledge Score | Continuous | Variable |
| 23. | ASVAB Math Knowledge | Continuous | Variable |
| 24. | ASVAB Mechanical Score | Continuous | Variable |
| 25. | ASVAB Electronic Information | Continuous | Variable |

### Job Specific Factors

| | | | |
|---|---|---|---|
| 26. | Paygrade | Continuous | E-3 - E-6 |
| 27. | Moral Waiver | 1 = If applicable | Else = 0 |
| 28. | Other Waiver | 1 = If applicable | Else = 0 |
| 29. | Admin Support MOS | 1 = If applicable | Else = 0 |
| 30. | Intelligence MOS | 1 = If applicable | Else = 0 |
| 31. | Logistics MOS | 1 = If applicable | Else = 0 |
| 32. | Combat Support MOS | 1 = If applicable | Else = 0 |
| 33. | Elec. Equipment Repair MOS | 1 = If applicable | Else = 0 |
| 34. | Communications MOS | 1 = If applicable | Else = 0 |
| 35. | Aircraft Operations MOS | 1 = If applicable | Else = 0 |
| 36. | Aircraft & Ordnance MOS | 1 = If applicable | Else = 0 |
| 37. | Supply MOS | 1 = If applicable | Else = 0 |
| 38. | Mechanic MOS | 1 = If applicable | Else = 0 |
| 39. | Months in Delayed Entry | Continuous | 0 - 12 |
| 40. | Summer Enlistee | 1 = If applicable | Else = 0 |
| 41. | Number of Promotions | Continuous | 2 - 5 |

number of dependents, age, test score) effects on quitting. The omitted group was those who did not need waivers to enlist. Next, due to the large number of MOSs, which even if broken down into DoD occupational groups was to unwildy, it was necessary to further generalize occupations using a common sense grouping. In this effort, I classified individuals using the lowest common denominator as a grouping criteria. For example, a Marine will be classified as administrative support regardless if he is a personnelman, record bookkeeper, or is an aviation supply clerk. Therefore, when the majority of an individual's work was in a specific area such as administration, he was classified as such regardless of the specifics of the unit in which he was assigned. This approach is taken to capture the specifics of job tasks an individual is involved in performing without including the effects of unit types. In this vein, 11 dummy variables were created. (See Table 1.) The omitted group was infantry. Additionally, two variables to reflect timing were included, these were months in the Delayed Entry Program and a summer enlistee (May-August). Finally, given the results of a recent Marine Corps Exit Survey which indicated promotions or lack thereof as the number one reason for separation, I included a variable to capture this effect. It was computed as the present paygrade minus the entry paygrade.

## C. THE MODEL

The basis on which the decision to leave or stay in the military is made, is assumed to be one of utility maximization. In my analysis I will apply the theory of utility maximization as outlined in the literature review and specifically use the model developed by Solnick [Ref. 9, p.5]. In this model, each of the three levels of variables (Personal Characteristics, Human Capital, and Job Specific Factors) contain a vector of characteristics that represent the particular attributes for each category.

In the most simple of these models a Marine at the reenlistment point would compare the present value of his expected lifetime utility with that of alternatives available to him. This model also takes into account any cost that might be incurred by the Marine in quitting such as, retraining an individual might need for a new job. The model is specified as follows:

(1) $Q = 1$ if $V(Uj) > V(Uo) + C$ (Marine Quits)

$Q = 0$ IF $V(Uj) < V(Uo) + C$ (Marine Reenlists)

Q = Quit

V(Uj) = discounted expected utility of alternative job j, j = 1,...n

V(Uo) = discounted expected utility to staying in Marines

C = Cost of quitting

[Ref. 9, p. 5].

This model specification provides the initial basis on which the decision to quit or stay occurs. However, it is exceedingly difficult for one to measure a utility. Utility is defined as "a number that represents the level of satisfaction that a consumer derives from a particular market basket" [Ref. 1, p. 15]. Given this definition, one also realizes that different people place different values on items in the market basket. As an example, a Marine with a family may derive higher satisfaction from medical benefits than someone who is single. This difficulty of measurement occurs for a wide variety of items that may effect the quit decision. Therefore, "since the expected utilities (and the cost of quitting) are not directly observable, the empirical model necessarily relies on proxy variables," [Ref. 9, p. 5]. Also, given that specific attributes can effect the quit decision through both the expected utility of a Marine's alternatives and that of reenlisting, the overall effect of that attribute will depend on its relative size. This relates to the question of how much satisfaction a married Marine may derive from the health care system as opposed to someone who is single. The overall measurement of a particulat attribute Xi on V(Uj) and V(Uo) implies:

$$\frac{\partial Q}{\partial X_i} = \frac{\partial V(Uj)}{\partial X_i} - \frac{\partial V(Uo)}{\partial X_i}$$ [Ref. 9, p. 6].

Given the development of the original model (1), a more specific and usable model can be developed by applying the following relationships:

(2) $V(Uj) = f(X_i)$

(3) $V(Uo) = f(X_i, w_j)$

(4) $C = h(Z_t, R, e)$ [Ref. 9, pp. 6-7].

Where

$X_i$ = personal characteristics

Wj = job specific characteristics that affect satisfaction and future promotion potential

$Z_t$ = variables reflecting family responsibilities

R = non-cash benefits (i.e., housing, health care, life insurance) increase with longevity

e = personal risk preference (a normally and independently distributed random variable [Ref. 9, p. 7].

Given the symbols defined above the final empirical model is obtained by substituting equations (2), (3), and (4) into (1).

(5) $Q = f(X_i, W_j, Z_t, R, e)$ [Ref. 9, p. 10].

## D. FUNCTIONAL FORM

Having expressed the fundamental model relationship above, the next issue of concern is what functional form should the model take on. The most widely used in the literature are the linear function, logistic function, and probit. Each of these models attempt to predict a specific dependent variable given one or more independent factors. Each functional form has certain advantages and can be used more accurately given a correct interpretation of the underlying relatioship between the dependent and independent variables in the model.

Each of these functional forms are:

Linear: $P = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_K X_K + \varepsilon i$
$p$ = dependent variable
$\alpha$ = constant term
$\beta_K$ = coefficient of attribute $X_K$
$X_K$ = explanatory variable
$\varepsilon i$ = error term

Logistic: $\ln \frac{P}{1-P} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_K X_K + \varepsilon i$

$\ln \frac{P}{1-P}$ = constrained dependent variable (0-1)

$\alpha$ = constant term
$\beta_K$ = coefficient of attribute $X_K$
$X_K$ = explanatory variable
$\varepsilon i$ = error term

Probit: $P = F(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_K X_K = F(Zi))$
$p$ = constrained dependent variable (0-1)
$F$ = cumulative normal probability distribution
$\alpha$ = constant term
$\beta_K$ = coefficient of attribute $X_K$
$X_K$ = explanatory variable
$Zi$ = an index determined by the explanatory variables $X_K$ and the estimated parameters $\alpha$ and $\beta_K$ .

The linear form is simplest, and easiest to interpret, given that the estimated coefficients can be interpreted to represent the increase in the probability of quitting when the corresponding explanatory variable is present. However, given that the dependent variable is in the interval from 0 to 1, there is a possibility that the use of the linear form may result in predicted probabilities that fall outside this range. "The obvious solution to the problem is to transform the original model in such a way that the predictions will lie in the (0,1) interval for all X" [Ref. 10, p. 280].

One possible solution is to use the logistic model which is based on the cumulative logistic probability function. The other is the use of the probit model which is associated with the cumulative normal probability function. The major difference between each model is, that the logit model is fatter in the tails, and therefore yields different values of the predicted probability value P(Z). Quite often the logit and probit models can be run as substitutes for one another. Therefore, my choice to use the probit method as the desired functional form stems from (1) the need to transform the dependent variable to the (0,1) interval, (2) the probit form implies a signoid (s shaped) relationship between the probabilities and characteristics, which better approximates the relationship than does the linear form, and (3) greater familiarity and use of the probit analysis technique.

In choosing the probit model I assume there exists an index $Z_i$ which is a linear function of the explanatory variable Xi, (i.e., $Z_i = \alpha + \beta x_i$). $Z_i$ can be thought of as a tendency toward doing something, in this case quitting the Marines. Note, one cannot observe $Z_i$, one only observes whether an individual will leave or stay. The problem still is to obtain estimates of $\alpha$ and $\beta$ and then of P, the probability of quitting. Therefore, I will assume that for each Marine a value $Z_i^*$ represents the critical cutoff value which translates the underlying index into a quit/stay decision. $Z_i^*$ is assumed to have a cumulative normal distribution.

Specifically: a Marine quits if $Z_i > Z_i^*$

a Marine stays if $Z_i < Z_i^*$.

Under these assumptions, the probit method provides consistent maximum likelihood estimates of the parameters $\alpha$ and $\beta$ .

## E. DATA AND MODEL SUMMARY

In summary, I will apply Solnicks' model of utility maximization to the first term, non-prior service Marines' decision to quit or stay in the military on completion of his four year contract. The method of analysis and functional form will be the probit model using the Statistical Package for the Social Sciences (SPSSX). There will be 12 models estimated, one for the entire group, and then separate models based on race, marital status, education, and finally, AFQT mental group.

# IV. EMPIRICAL RESULTS

This section will discuss and present the estimated models for the entire population, as well as the selected models based on marital status, race, education, and AFQT grouping. Additionally, I will review differences and similarities that exist in the parameter estimates between the original model and the selected demographic models.

## A. IMPLICATIONS OF THE MODEL

The parameter estimates for the quit model are presented in Table 2. They provide a general assessment of the importance of the factors that I have chosen. This model may be used for a more specific purpose than just determining importance of factors that affect the quit decision. Specifically, this model can be used to calculate the predicted quit rate for any given values of the independent variables. These calculations can be used to measure to what extent the quit rate of first term enlisted Marines could be affected, if Headquarters Marine Corps, the Department of the Navy (DoN) or other higher government agencies effected policy changes that resulted in altering the values of the factors included in the model. As one example, I can estimate what the effect of increasing promotions, changing education requirements, or increasing compensation will have on a Marine's decision to leave or stay.

This model strongly suggests that there are eight factor areas that have a significant effect on the decision to quit. These are (1) marital status, (2) age, (3) race, (4) non-high school graduates, (5) scores from word and math knowledge sections of ASVAB, (6) job specific MOS, (7) pay-grade and compensation, and (8) promotion.

First, the effect of being married on quits was relatively large, negative, and significant at the above 5% level. In the data set 37 percent were married. Given the large demands the Marine Corps places on a young Marine's time one might expect family pressures to lead to a higher propensity to quit. What this model shows however, is that being married acts as a stabilizer for first term Marines and actually increases the probability the Marine will stay in. The economics occurring here reflect that married Marines have a higher cost of quitting than do singles due to payment of subsistence and housing allowance to married Marines. In fact, the basic Marine Corps policy is that single Marines will live in provided quarters (usually a barracks with 2 to 3 man rooms) and take all meals in the enlisted dining facility. This is a point of contention among young single Marines who feel they would rather receive the cash benefit in order to provide the mix of goods (housing and food) that maximize their individual utilities. Additionally, married Marines receive a slightly higher allowance for housing which is generally perceived as unfair. Therefore, referring back to the original model in equation (1), the married Marine has a higher cost associated with quitting and, therefore, is more likely to stay in.

Second, the age of a Marine at the end of his contracted enlistment had a negative and significant effect at the 5 percent level on quitting. This result is as anticipated, given that the older the individual is on leaving the Marine Corps the less time available to him to recoup the cost for any training needed in the civilian labor market. Additionally, being older at the end of a contract implies the initial enlistment age of the individual was older, and a possible reason to enlist was an inability to find employment opportunity equal to what the Marine Corps offered in the civilian labor marked. Therefore, one would anticipate that those with previous bad experiences in finding acceptable employment in the civilian labor market would not be anxious to return.

Third, the effect of being black was relatively large, negative, and significant at 5 percent, whereas being in the other minority races has a smaller, negative effect, and is also significant at 5 percent. This result is due to a perceived equality of treatment of minorities within the Marine Corps as opposed to opportunities availables to non-whites in the civilian labor market. In as much that discrimination in the market place does occur it drives up the cost of

## TABLE 2

## PROBIT ESTIMATES OF PARAMETERS OF QUIT MODEL

| N = 12,295 | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.47058 | -12.28987** |
| Number of Dependents | .01363 | .59453 |
| Age at End of Contract | -.02007 | -2.17490** |
| Black | -.53093 | -13.16660** |
| Other Race (Asian, Indian, etc) | -.14834 | -2.19918** |
| Mid-Atlantic | .02494 | .60025 |
| West/North/Central | -.02179 | -.42557 |
| South-Atlantic | -.06796 | -1.64533 |
| East/South/Central | -.01391 | -.21757 |
| West/South/Central | -.03855 | -.66613 |
| Mountain Region | -.11608 | -1.79709* |
| Pacific Region | .08459 | 1.54762 |
| New England | .09714 | 1.57475 |
| Non-High School Graduate | .15522 | 1.81698* |
| Some College Education | .06615 | .95248 |
| College Degree | .53014 | 2.33858** |
| Junior ROTC Experience | -.12655 | -1.40445 |
| General Science | .01296 | .53274 |
| Word Knowledge | -.08002 | -3.32074** |
| Math Knowledge | -.06680 | -3.84026** |
| Mechanical Comp | .02386 | 1.17820 |
| Electronic Information | .02748 | 1.58937 |
| Paygrade | -.43562 | -13.47299** |
| Moral Waiver | .08238 | 2.86636** |
| Other Waiver | -.00688 | -.09513 |
| Admin Support MOS | -1.03364 | -14.96523** |
| Intelligence MOS | -.63056 | -4.59177** |
| Logistics MOS | -.96314 | -11.91096** |
| Combat Support MOS | -.78571 | -13.02834** |
| Elec. Equipment Repair MOS | -.56020 | -9.68342** |
| Communications MOS | -.74065 | -11.13811** |
| Aircraft Repair Ord. MOS | -.83380 | -13.90975** |
| Supply MOS | -.81597 | -11.01003** |
| Mechanic MOS | -.86291 | -13.01083** |
| Aircraft Operations MOS | -.82661 | -10.09061** |
| Months in Delayed Entry | -.01361 | -3.06636** |
| Summer Enlistee | -.44861 | -13.41405** |
| Number of Promotions | .26003 | 4.59268** |
| AFQTGI | -.09511 | -.94065 |
| AFQTGII | -.06891 | -1.06805 |
| AFQTGIII | -.08238 | -1.47849 |
|  | INTERCEPT | INTERCEPT/S.E. |
|  | 9.86578 | 38.42877 |

PEARSON GOODNESS OF FIT CHI SQUARE=12413.225 DF=12253 P=.153

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

quitting for blacks, and other non-whites. This cause helps explain the disproportionate number of blacks and non-whites in the Marine Corps as a percentage of the population as a whole. Additionally, non-pecuniary benefits received as one proceeds through the rank structure, such as responsibility, respect and authority, historically will be much higher for non-whites in the Marine Corps than in the civilian labor market. This effect will cause a higher discounting of alternatives available and results in blacks and other non-whites displaying higher propensity to remain in the Corps than whites.

Fourth, the effect of education on quits is broken down into those without high school degrees and those with some college. No high school degree had a positive effect on quits and was significant at 10 percent. This result is supported by Blandin [Ref. 12], Boesel and Johnson [Ref. 13], Buddin [Ref. 11] and others, and indicates that those without a degree lack the stick-to-it attitude of their graduate counterparts. Those who had some college had a small positive effect on quits but it was insignificant. Those who received college degrees had a large positive effect on quits and was significant at the 5 percent level. This result is as expected since with a large investment in human capital these individuals expect a high wage in the civilian labor market. Interestingly, the Marine Corps offers a tuition assistance program to enlisted members and encourages them to gain as much college experience as possible in their time off. The idea is that this process will result in a better qualified, more productive Marine. Given the results of this model, it appears that what actually occurs is a greater likelihood of quitting. Therefore, in the shadow of tightening defense budgets the Marine Corps should review this program for cost effectiveness to see if the productivity increase is large enough to offset the future loss of that Marine. Intuitively, I think not given that the additional education is general and where young Marines are weakest is their job specific skills.

Fifth are the effects of an individual's score on the word knowledge and math knowledge sections of the ASVAB. Each of these factors are negative and significant at the 5 percent level, contrary to expectation. Interestingly, the ASVAB uses as a measure of "Academic Ability," the sections Word Knowledge, Paragraph Comprehension, and Arithmetic Reasoning. Additionally, verbal skills are measured with the use of word knowledge. Math knowledge is used to measure one's ability to apply mathematical principles and arithmetic skills to problem solving. These measures, therefore, reflect previous investments in human capital, specifically education an individual has attained. Therefore, if given two individuals both with high school degrees and equal in all other apsects, I would anticipate the one with the higher scores to be more likely to quit at the end of his enlistment. This result would follow from human capital theory since the individual with more ability would perceive more alternatives of greater value in the market place and, therefore, have a higher propensity to quit.

Sixth, the ten variables representing job specific factors revealed in all cases a large, negative, and significant effect on quits at the 5 percent level. The omitted segment in the model were those in the infantry MOS. This result indicates that those who serve in non-infantry billets are much more satisfied with their job. In line with job-matching/job satisfaction theory, I would then expect that those Marines in other than infantry jobs would associate a higher loss of utility and greater cost to quit than would an infantryman. There are primarily two reasons for these results, first for those serving in an infantry job in their first enlistment the job is physically demanding, consumes large amounts of what would otherwise be leisure time on field exercises and deployments, and generally is perceived to be the lowest on an ad hoc scale of desirability. Hence, the Infantry are referred to as "grunts." Second, while these "grunts" do receive extensive training in tactics, small arms marksmanship, land navigation, and many areas of a combat origin, they are all specific skills with little transferrability to the civilian labor market. One might expect this job specific skill would keep the infantryman in the Marines more so than the other MOSs. However, recall that a specific attribute such as MOS can effect the quit decision through both the expected utility of a Marine's alternatives and that of reenlisting, and the overall effect of that attribute will depend on its relative size.

Specifically: $$\frac{\partial Quit}{\partial MOS_i} = \frac{\partial V(U_j)}{\partial MOS_i} - \frac{\partial V(U_o)}{\partial MOS_i}$$

In the case of an infantryman the effect of the possible alternatives $V(U_j)$ for a specific MOS for individual i are greater than the utility received if the Marine reenlists $V(U_o)$. Therefore, the amount of dissatisfation that occurs for this individual overwhelms the benefit received for reenlisting and applying the job specific skills learned.

In line with human capital theory and job-specific versus general skills, it can be seen that those in the more technical MOSs, for example, the electrical equipment repair, have the highest propensity to quit. While this results is not startling it certainly indicates that the Marine Corps is losing those individuals it needs most desparately, its infantrymen and skilled technicians. As a result the Marine Corps experiences job crowding in the MOSs with the lowest propensity to quit, in this model it indicates those in the administrative support field, which certainly reflects the current situation.

Seventh, are the effects of paygrade on quits which is negative and significant at the 5 percent level. This factor represents compensation, and as such may inculcate certain weaknesses of individuals to underestimate the true value of their total income. As an example, tax advantages, medical benefits, housing, and subsistence. However, I assume that if this weakness exists, that it is the same among all in the sample and, therefore, should not result in a biased factor. This result is supported by Chow and Polich [Ref. 17] who found that "when sample members came to the point where they had to decide on reenlistment, they behaved as though their actual levels of compensation, and not their perceptions, were the principal factor in the decision" [Ref. 17, p. 36]. Therefore, the more pay received the less likely a Marine would be to quit. This is in line with the original model, where the Marine who is payed more has a higher cost of quitting.

Finally, the promote factor is significant at the 5 percent level and has a positive effect on quitting. This result poses an interesting question, in that the number one reason for separation found in the 1986 exit survey of Marine Corps enlisted personnel was lack of promotion. Therefore, one might hypothesize that to reduce quits, a balancing out of promotion rates between occupational specialties is needed. This change may reduce quits overall, but result in a higher quit rate among the best qualified Marines who would perceive less promotion opportunity and rewards for their greater innate abilities. I believe that my model as specified shows the correct results of promotions on quitting, since those who are promoted most quickly are ambitious, dedicated individuals with larger investments in personal human capital. The exit survey on the other hand is simply a tabulation of responses from those offered and suggest no statistical association between the intended behavior of a particular group and the responses given. In essence, it appears to be a "sour grapes" type attitude and reveals only something about the quit population from which the sample is taken. I would expect that those who are promoted most frequently would derive a higher utility from these alternatives than remaining in the Marines. As an example it is possible for an individual to be meritoriously promoted to Sergeant within three years of enlistment. Then by spending two consecutive tours on the "drill field" (recruit training depot) can be promoted to Gunnery Sergeant. The alternatives available to this individual along with the general training in management skills would raise the likelihood of a quit.

The Marine Corps, and armed services in general, try to counter this result through the retirement and benefits associated with twenty years of service. But as evidenced in this model, the erosion of the benefits, which in the past has raised the cost of quitting, will become much less important and result in a higher quit rate.

Another interesting result from this model, was that those who spent a longer time in the Delayed Entry Program pool, had a negative and significant effect on quits. This relates to the individual most probably receiving a good job match into the MOS he desired, justifying a long wait. Also, a timing issue, were those who were summer enlistees, show a significant and negative effect on quits. This reflects that those entering at this time are the high-school graduates who are most likely to remain in the Marine Corps. While those who enlist during other times in the year do so more out of an inability to get or keep another job and thus are classified as "labor market lemons".

## B. PREDICTIVE MODEL SELECTING ON MARITAL STATUS

The parameter estimates for the quit models selecting on married and single personnel can be seen in Table 3. The basic assumption is that given the same model married Marines will behave differently than their single counterparts. The parameter estimates assess the effect of factors on quit behavior, and in what direction (positive or negative), will being married tend to move, more toward staying or leaving the Marine Corps.

The first difference between the models can be seen in the end age factor. This variable is very small (.01) for married Marines, and is not significnt. However, the same variable has a negative and significant effect at the 5 percent level on singles quit behavior. While in the general population model we see that singles are more likely to quit, this further shows that the younger a single Marine is the more likely he is to quit. This reflects the low quitting cost against him and the availability to still further invest in other human capital activities with enough time to recoup that investment.

The race factor is not significant in either the married or single population models. This result is not as expected. Since in the original model race was significant at the 5 percent level and negative. Therefore, in the models selecting on marital status, the race effect on quit behavior cannot be determined.

The variables that try to capture the effect of region of enlistment on quits were insignificant in the general population model. These factors attempt to measure if certain regions turn out Marines who have a greater propensity to quit. The first time this factor does become significant is for singles from the Mountain region. The effect on quits is negative and significant at the 5 percent level. Interestingly, the variables for the Pacific and New England regions are positive for both singles and married. The parameter estimates for these two variables are not significant but pose an interesting area for further research on regional factors affecting quits.

The education factor results showed that for both single and married Marines there was a positive effect on quits for non-high school graduates and those with college education. Again, those who had received a college degree had a much higher propensity to quit than those with only some college.

The variables reflecting academic ability from the ASVAB being word and math knowledge was negative, small, and significant at the 5 percent level for both groups. This factor is similar to the results found in the general model (Table 2) with the parameter estimates being very similar. This consistency implies that these sections from the ASVAB are good estimators of quit probability. Another consistent estimator of quit probability between models is paygrade, which is negative and significant and has almost identical effects on the quit decision regardless of marital status.

Given the increase in the number of waivers being given on enlistment, I tried to establish if any significant differences exist between those who quit or stay based on the type of waiver granted. Principally, waivers are given for moral reasons (excessive speeding tickets, misdemeanor arrests, or experimental drug use) or other reasons (number of dependents, age, test score). Implicitly, I assume that since those in the group who receive waivers have greater difficulty entering the Marines they are less likely to quit

## TABLE 3

### PROBIT ESTIMATES BY MARITAL STATUS

| | MARRIED (N = 4219) | | SINGLE (N = 8,076) | |
|---|---|---|---|---|
| | REGRES COEFF | COEFF/S.E. | REGRES COEFF | COEFF/S.E. |
| Number of Dependents | .01684 | -.69226 | -.07948 | -1.05062 |
| Age at End of Contract | .01070 | .74457 | -.04351 | -3.46688** |
| Black | -.02514 | -.37357 | .05650 | 1.06174 |
| Other Race (Asian, etc) | -.43681 | -6.36518** | -.58803 | -11.72259** |
| Mid-Atlantic | -.17848 | -1.75309* | -.13360 | -1.46818 |
| West/North/Central | -.02980 | -.36584 | -.01361 | -.20560 |
| South-Atlantic | -.07952 | -1.22334 | -.05458 | -1.01406 |
| East/South/Central | .03777 | .38796 | -.05430 | -.64088 |
| West/South/Central | .01077 | .12197 | -.07573 | -.98860 |
| Mountain Region | -.03669 | -.36598 | -.17310 | -2.05328** |
| Pacific Region | .07733 | .90589 | .09515 | 1.32833 |
| New England | .04651 | .43838 | .11646 | 1.52251 |
| Non-High School Grad | .28630 | 2.23428** | .05515 | .48390 |
| Some College Education | .08453 | .80458 | .05761 | .62017 |
| College Degree | .45368 | 1.33674 | .54842 | 1.83283* |
| Junior ROTC Experience | -.02476 | -.15841 | -.19312 | -1.75495 |
| General Science | .01824 | .47587 | .00953 | .30097 |
| Word Knowledge | -.08797 | -2.28073** | -.07634 | -2.45792** |
| Math Knowledge | -.05995 | -2.18720** | -.07153 | -3.15785** |
| Mechanical Comp | .01723 | .52959 | .02991 | 1.14812 |
| Electronic Information | .04543 | 1.66478 | .01629 | .72467 |
| Paygrade | -.45205 | -8.60369** | -.42213 | -10.23850** |
| Moral Waiver | .12121 | 2.63721** | .05913 | 1.59629 |
| Other Waiver | -.07675 | -.76324 | .07924 | .74002 |
| Admin Support MOS | -.95712 | -9.22325** | -1.09336 | -11.77459** |
| Intelligence MOS | -.78234 | -3.85319** | -.49767 | -2.56740** |
| Logistics MOS | -.97773 | -7.88259** | -.94504 | -8.77428** |
| Combat Support MOS | -.72902 | -7.84095** | -.82688 | -10.35620** |
| Elec. Equip. Repair MOS | -.52446 | -5.83728** | -.58896 | -7.71347** |
| Communications MOS | -.66519 | -6.29823** | -.78758 | -9.11461** |
| Aircraft Rep Ord. MOS | -.80447 | -8.65039** | -.85869 | -10.84810** |
| Supply MOS | -.81226 | -7.07501** | -.82183 | -8.40719** |
| Mechanic MOS | -.84582 | -8.20893** | -.87725 | -10.04898** |
| Aircraft Ops MOS | -.86020 | -6.91633** | -.80380 | -7.29669** |
| Months in Delayed Entry | -.00749 | -1.03263 | -.01744 | -3.08586** |
| Summer Enlistee | -.40391 | -7.85864** | -.48572 | -10.92426** |
| Number of Promotions | .36038 | 4.07486** | .18180 | -2.45659** |
| AFQTGI | -.14303 | -.85566 | -.07421 | -.57889 |
| AFQTGII | -.08924 | -.87362 | -.06208 | -.74186 |
| AFQTGIII | .07020 | -.78822 | -.09028 | -1.25808 |
| | INTERCEPT | INTERCEPT/SE | INTERCEPT | INTERCEPT/SE |
| | 8.19708 | 21.33059 | 9.94037 | 29.76737 |

MARRIED
PEARSON GOODNESS-OF-FIT CHI SQUARE = 4235.775 DF = 4178 P = .262
SINGLE
PEARSON GOODNESS-OF-FIT CHI SQUARE = 8250.836 DF = 8035 P = .045

*SIGNIFICANT AT 10 PERCENT
**SIGNIFICANT AT 5 PERCENT.

at the end of their enlistment. Additionally, the number of alternatives - $V(U_j)$ - available are less given they have existing conditions that limit their employment opportunities. However, the results indicate just the opposite, for those married there is a positive and significant effect at the 5 percent level, and for single Marines there is a positive effect on quits although significant only at about the 15 percent level. What these results imply is that those who enter under waivers are more likely to quit than their non-waiver counterpart. The economic explanation to this phenomenon may lie in the fact that those who receive waivers are "labor market lemons" and as such perform poorly in their regular duties. Given this they perceive less alternatives and promotions are available to them if they remain in the Marines and, therefore, heavily discount any benefits. Hence, a lower cost of quitting and at least some limited alternatives would lead to the decision to quit.

For both single and married Marines the variables which model job-specifics (MOS) are negative and significant. The omitted group infantry is revealing itself as a strong indicator of a Marine's future intention to remain. All MOSs have a much higher propensity to quit regardless if the individual is single or married. In both models Administrative Support MOSs have the largest negative effects on quits and Electronic Equipment Repair the smallest. These results support the findings for the general population model in Table 2.

The factors associated with time of entry, indicate that the longer one remained in the Delayed Entry Pool and those who enlisted in the summer were less likely to quit. This result was the same for married and single Marines.

The promotion factor had a positive effect on quits, and was significant at the 5 percent level. Note, however, that the effect was almost twice as large for married Marines. Given the same alternatives, I would anticipate that a married Marine would have higher quitting cost and thus be the group less likely to quit given the same number of promotions. An explanation may lie in the fact that married Marines' wives often forfeit income due to frequent moving. Therefore, given the husband has a more stable alternative it could increase his wife's earning potential and increase the likelihood of quitting.

Finally, the factors which model mental ability, (AFQT) indicate a small negative effect on quits for all groups. These factors are not significant in any model. While traditionally in the literature this variable is a good estimator of quit behavior, in this case it turns out not to be so. Actually, the math and word knowledge sections of the ASVAB do a better job at modelling mental ability than the composites which make up the AFQT score.

The ability of the models to correctly predict quits selecting on marital status were:

Married - 84.8 percent correct

Single -- 94.2 percent correct.

## C. PREDICTIVE MODEL SELECTING ON RACE

The parameter estimates for the quit models selecting on blacks or whites can be seen in Table 4. Given the strong significance of the race factor in the general model, I would expect that blacks will be less likely to quit, ceteris paribus. The parameter estimates indicate differences between blacks and whites in the importance of the other factors that affect quitting.

The models indicate that being married has a significant and negative effect on quitting. This is in line with the general model. Having hypothesized that discrimination in the market place raises the cost of quitting for blacks, I would anticipate that being a married black would raise the cost to quit even more. Therefore, in the model selecting on blacks, I have anticipated a much larger negative effect on quits for blacks than whites (given both models are identically specified). This result indicates that social values about marriage within the black community may effect the quit decision differently than whites. However, this thesis lacks sufficient data to investigate this issue and further research is needed.

## TABLE 4

## PROBIT ESTIMATES BY RACE

| | WHITES (N = 10,084) | | BLACKS (N = 1,692) | |
|---|---|---|---|---|
| | REGRES COEFF | COEFF/S.E. | REGRES COEFF | COEFF/S.E. |
| Married | -.50058 | -11.70775** | -.37138 | -3.70136** |
| Number of Dependents | .01946 | .75092 | .00386 | .06590 |
| Age at End of Contract | -.00666 | -.63469 | -.07394 | -3.18814** |
| Mid-Atlantic | .04423 | .96090 | -.12269 | -1.18499 |
| West/North/Central | -.00468 | -.08687 | -.08718 | -.44469 |
| South-Atlantic | -.03187 | -.66940 | -.17450 | -1.83270* |
| East/South/Central | .02112 | .28629 | -.13659 | -.98310 |
| West/South/Central | -.05652 | -.89084 | .08334 | .51294 |
| Mountain Region | -.12648 | -1.88703* | -.14354 | -.22037 |
| Pacific Region | .11695 | 1.89655* | .07412 | .36988 |
| New England | .09037 | 1.38733 | .13469 | .60701 |
| Non-High School Grad | .18048 | 1.93523* | .03262 | .11241 |
| Some College Education | .00718 | .09288 | .31744 | 1.66118 |
| College Degree | .08689 | .30470 | 1.53278 | 3.59656** |
| Junior ROTC Experience | -.17274 | -1.61724 | .05253 | .29444 |
| General Science | .01355 | .49032 | -.02178 | -.36644 |
| Word Knowledge | -.08966 | -3.30441** | -.05231 | -.84502 |
| Math Knowledge | -.06770 | -3.46090** | -.09683 | -2.19491** |
| Mechanical Comp | .04699 | 2.05961** | -.05315 | -1.04427 |
| Electronic Information | .00694 | .35398 | .12896 | 2.94391** |
| Paygrade | -.34949 | -9.64893** | -.72604 | -9.05699** |
| Moral Waiver | .07657 | 2.42328** | .03705 | .44646** |
| Other Waiver | .01702 | .19246 | -.10054 | -.64814 |
| Admin Support MOS | -1.00197 | -12.88158** | -1.13936 | -6.38263** |
| Intelligence MOS | -.55822 | -3.89915** | -.80251 | -1.33715 |
| Logistics MOS | -.94821 | -10.68500** | -.98519 | -4.35261** |
| Combat Support MOS | -.74002 | -11.24016** | -.98829 | -5.86154** |
| Elec. Equip. Repair MOS | -.51553 | -8.20649** | -.69259 | -4.16718** |
| Communications MOS | -.65650 | -8.77333** | -.99304 | -5.85107** |
| Aircraft Rep Ord. MOS | -.77021 | -11.84469** | -.99227 | -5.64753** |
| Supply MOS | -.70584 | -8.10138** | -1.07150 | -6.11131** |
| Mechanic MOS | -.74237 | -10.03523** | -1.22767 | -6.91516** |
| Aircraft Ops MOS | -.77018 | -8.68738** | -1.05276 | -4.12231** |
| Months in Delayed Entry | -.01456 | -2.91899** | -.01229 | -1.08596 |
| Summer Enlistee | -.42335 | -11.34969** | -.62176 | -6.97377** |
| Number of Promotions | .18257 | 2.95938** | .43327 | 2.49805** |
| AFQTGI | -.13949 | -2.22902 | .68365 | 1.17836 |
| AFQTGII | -.08181 | -1.02139 | .03777 | .25092 |
| AFQTGIII | -.08884 | -1.21371 | -.05896 | -.58073 |

| INTERCEPT | INTERCEPT/SE | INTERCEPT | INTERCEPT/SE |
|---|---|---|---|
| 9.27309 | 31.88321 | 11.67966 | 18.53763 |

WHITES
PEARSON GOODNESS-OF-FIT CHI SQUARE = 10095.152 DF = 10044 P = .358
BLACKS
PEARSON GOODNESS-OF-FIT CHI SQUARE = 1723.441 DF = 1652 P = .108

*SIGNIFICANT AT 10 PERCENT
**SIGNIFICANT AT 5 PERCENT.

The factor that captures age has a negative and significant effect for the blacks. This result supports the hypothesis that older blacks face a higher cost of quitting than do their younger counterparts, which is a function of their ability to recoup any investments in human capital needed for an alternative job. In the model selecting on whites this value is almost zero and not significant.

The regional variables which heretofore have been difficult to interpret present some significant parameter estimates. Considering that there exists geographic concentrations of individuals of different races I anticipated that certain regions (for example, the South Atlantic for blacks) would provide significant information on the propensity to quit for Marines who enlist from these areas. Interestingly, being black and from the South Atlantic region had a significant and negative effect on quits at the 10 percent level. The other regions did not have a significant effect on the quit decision for blacks. The South Atlantic regional factor does indicate that regions in which black Marines are recruited from can be analyzed to determine future quit probabilities, and allow recruiting efforts to be focused in regions that result in the desired force structure requirements of the future. In the model for whites the regions of the Pacific and New England also had a positive effect on quits and in this model, Pacific region was significant at the 10 percent level. Additionally, Blandin's [Ref. 12, pp. 12-13] parameter estimates for early attrition indicate that the Pacific and New England region had positive effects on early separation. This indicates that individuals recruited from these two regions have a higher propensity to leave the Marines.

The education factor again shows consistent results for both blacks and whites, where those without high school degrees or some college are more likely to quit than high school graduates.

Once again, in both models selecting on blacks and whites, the results indicate that the word and math knowledge sections of the ASVAB are significant and have a negative effect on quits. The parameter estimates for both models are similar to those in the general model and further support these factors' importance in determining quits.

The variable reflecting compensation (paygrade) is negative and significant at the 5 percent level in both models. The parameters indicate blacks are about twice as sensitive to changes in pay as whites; thus, a pay change would have a greater impact on their decision to quit.

A unique result for the parameter estimates of specific MOS effects on quits indicate that for blacks there exists a negative and significant effect on quits. In previous models being in the administrative support MOS had the largest negative effects on quits. For the model selecting on blacks it becomes mechanics (-1.22). This result indicates that blacks in all other MOSs are more likely to stay than the omitted group infantry. However, through personal observation a large proportion of blacks serve in the infantry and combat support MOSs than in the more technical fields. This suggests that blacks who are in these more technical fields perceive a greater opportunity exists for them in their specialized MOS than may exist in the infantry, which I certainly believe is true due to the overcrowding in the higher combat MOS ranks. In the model for whites the parameter estimates for specific MOSs were more in line with those of the general model. Also, in both race groups the electric equipment repair MOS had the smallest negative effects on quits, again indicating that MOS as being the next most likely to quit after infantry.

The factors that measured timing of entry, months in DEP, and summer enlistees were significant and negative in both race models. Again, the results were similar to the general model.

Finally, the promotion factor had a positive and significant effect on quits in both race models. In the model for blacks the parameter estimate of .43 indicates greater ability and more alternatives available and, thus, a greater propensity to quit. In the model for whites the estimate was half that for the black model which may indicate a shortage of highly capable blacks in the market place. Therefore, those black Marines who distinguish themselves are given a wider range and better alternatives from which to choose.

The ability of the race models to correctly predict quits was:

White Model: 85.7 percent correct

Black Model: 67.9 percent correct.

## D. PREDICTIVE MODEL SELECTION ON EDUCATION

The parameter estimates for the quit models selecting on non-high school graduates, high school graduates, and those with college education can be found in Tables 5-7.

### 1. Non-High School Graduates (Table 5)

The factors which model the personal characteristics reflect the same results found in the previous models. Specifically, being a married, older, minority non-graduate has a negative effect on quits. Certainly, the cost of quitting would be high to these individuals given a lack of alternatives and limited educational skills.

The factors which reflect regional differences in propensity to quit were all insignificant. Although not significant, the New England and Pacific regions had a positive effect on quits. This result may be influenced by social norms in these regions which place lower value on service to country ethics. However, more data are needed to provide characteristics of intention to remain in the Marines, given specific regional values, to substantiate this theory.

## TABLE 5

## PROBIT ESTIMATES OF PARAMETERS FOR NON-HIGH SCHOOL GRADUATES

| (N = 402) | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.57309 | -2.07482** |
| Number of Dependents | .21057 | 1.32475 |
| Age at End of Contract | -.10254 | -1.88689* |
| Mid-Atlantic | .34731 | .97935 |
| Black | -.92084 | -2.48863** |
| Other Race (Asian,etc) | -.49588 | -1.27228 |
| West/North/Central | .13418 | .37790 |
| South-Atlantic | .16910 | .53027 |
| East/South/Central | -.70046 | -1.18088 |
| West/South/Central | .01360 | .03965 |
| Mountain Region | -.46033 | -1.34071 |
| Pacific Region | .23175 | .63308 |
| New England | 2.52415 | .75401 |
| Junior ROTC Experience | -.41054 | -.67177 |
| General Science | .09758 | .53098 |
| Word Knowledge | -.02698 | -.15442 |
| Math Knowledge | .08358 | .61105 |
| Mechanical Comp | .16070 | 1.16972 |
| Electronic Information | -.24727 | -1.77048 |
| Paygrade | -.93541 | -3.40594** |
| Moral Waiver | .03388 | .15607 |
| Other Waiver | .07815 | .16532 |
| Admin Support MOS | -.08580 | -.12287 |
| Intelligence MOS | -2.03673 | -1.93020* |
| Logistics MOS | -.80754 | -1.14018 |
| Combat Support MOS | -.86641 | -1.72592 |
| Elec. Equip. Repair MOS | -.68351 | -1.45024 |
| Communications MOS | -1.69822 | -3.15769** |
| Aircraft Repair Ord. MOS | -.98692 | -1.89943* |
| Supply MOS | -.70773 | -1.28703 |
| Mechanic MOS | -.87428 | -1.55340 |
| Aircraft Operations MOS | -1.90009 | -2.40388** |
| Months in Delayed Entry | .00383 | .08506 |
| Summer Enlistee | -.36349 | 1.63872* |
| Number of Promotions | .11615 | .24580 |
| AFQTGI | -1.14654 | -1.20213 |
| AFQTGII | -.45667 | -.59783 |
| AFQTGIII | -.54727 | -.74871 |
|  | INTERCEPT | INTERCEPT/SE |
|  | 13.93385 | 7.50360 |

PEARSON GOODNESS OF FIT CHI SQUARE=399.555 DF= 363 P=.090

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

In trying to model the human capital factors effect on quits, it has been shown that word and math knowledge have provided significant parameter estimates with consistent results. The other factors which attempt to capture the effect of academic ability (AFQT group) were not significant.

Another result in this model was that 11 of the MOS variables had a negative effect on quits but only four were significant. Those in the intelligence field had the largest negative parameter estimate, which previously had been administrative support. Consistent with previous model parameter estimates those in the electronic equipment repair MOS had the smallest negative effect on quits.

The timing factors which looked at time in the Delayed Entry Pool was virtually zero, and summer enlistees had a negative effect on quits. Additionally, promotions had a positive effect on quits as anticipated.

Consistent with the original model the parameter estimates for both paygrade and blacks were negative and significant at the 5 percent level.

This model predicted correctly 92.8 percent of all those non-high school graduates who quit.

### 2. High School Graduates (Table 6)

Given the largest proportion of the sample population is composed of high school graduates I anticipated that these results would be similar to the general model Table 2.

TABLE 6

PROBIT ESTIMATE OF PARAMETERS FOR HIGH SCHOOL GRADUATES

| (N = 11,329) | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.48151 | -12.07261** |
| Number of Dependents | .01115 | .46437 |
| Age at End of Contract | -.02053 | -2.07068** |
| Mid-Atlantic | .01834 | .42716 |
| Black | -.55352 | -13.25401** |
| Other Race (Asian,etc) | -.14148 | -1.98575* |
| West/North/Central | -.02009 | -.37730 |
| South-Atlantic | -.05905 | -1.37682 |
| East/South/Central | .-1486 | .22361 |
| West/South/Central | -.02612 | -.43162 |
| Mountain Region | -.08178 | -1.20574 |
| Pacific Region | .07113 | 1.24794 |
| New England | .09755 | 1.52791 |
| Junior ROTC Experience | -.13813 | -1.45735 |
| General Science | .01094 | .43386 |
| Word Knowledge | -.08024 | -3.20952** |
| Math Knowledge | -.07485 | -4.16723** |
| Mechanical Comp | .01976 | .93933 |
| Electronic Information | .02894 | 1.61412 |
| Paygrade | -.44919 | -13.14121** |
| Moral Waiver | .07594 | 2.54719** |
| Other Waiver | -.00791 | -.10409 |
| Admin Support MOS | -1.02171 | -14.07016** |
| Intelligence MOS | -.64825 | -4.38074** |
| Logistics MOS | -.96425 | -11.41223** |
| Combat Support MOS | -.78210 | -12.50302** |
| Elec. Equip. Repair MOS | -.54957 | -9.13934** |
| Communications MOS | -.70830 | -10.29225** |
| Aircraft Repair Ord. MOS | -.83216 | -13.39326** |
| Supply MOS | -.79992 | -10.41923** |
| Mechanic MOS | -.85107 | -12.43904** |
| Aircraft Operations MOS | -.79225 | -9.25970** |
| Months in Delayed Entry | -.01319 | -2.90251** |
| Summer Enlistee | -.47330 | -13.36855** |
| Number of Promotions | .28772 | 4.83221** |
| AFQTGI | -.07780 | -.71675 |
| AFQTGII | -.05110 | -.77663 |
| AFQTGIII | -.06711 | -1.18935 |
|  | INTERCEPT | INTERCEPT/SE |
|  | 13.93385 | 7.50360 |

PEARSON GOODNESS OF FIT CHI SQUARE=399.555 DF= 363 P=.090

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

This was the case as can be seen by comparing the parameter estimates for Table 2 and Table 6.

For the personal characteristics factors it is seen that being married, older, and a minority all have a significant negative effect on quits. Again, in this model the regional factors of Pacific and New England have a consistent positive parameter estimate, though not significant at the 10 percent level. The factors which estimated human capital investment, and specifically academic ability, all have negative parameter estimates for their effects on quits, but were not significant, showing that high school graduates regardless of mental group behave similarly.

Finally, the job specific factors were all negative and significant at the 5 percent level with the administrative support MOS having the largest negative effect on quits, and electronic equipment repairman the smallest. Again, the timing of entry variable responded with negative estimates for reasons explained in the general model. Receipt of promotions had a positive effect on quits, as anticipated.

This model correctly predicted 90.7 percent of all high school graduates who quit.

### 3. Some College Education (Table 7)

This sub-sample of the population represents those who have taken time to invest more in human capital than their counterparts. Generally, the Marine Corps encourages education but provides little incentive for an enlistee, particularly in his first term, to obtain a college education. Specifically, these are no pay benefits, or opportunities for early promotion based solely on education. Therefore, those individuals who obtain college credit or degrees during their first enlistment are assumed to have an alternative agenda of entering an officer's commission program, or leaving the Marine Corps at the end of their contract.

Having described the characteristics of this group as one with a higher propensity to quit I would anticipate smaller negative parameter estimates on those factors that model personal characteristics and large negative parameter estimates for specific MOS's, since the omitted group is infantry, which has been shown to be the group with the largest propensity to quit. Therefore, given an infantryman with a college education as compared to any other job, his likelihood of leaving at the end of his contract is very high, as has been my general observation.

In the general model (Table 2), the parameter estimates show that being married or in a minority group has a negative effect on quits, but here they are not significant. However, those who are older at the termination of their contract are more likely to quit, although this effect is not significant. In this group, this result is anticipated since they would desire to recoup their human capital

## TABLE 7

## PROBIT ESTIMATES OF PARAMETERS FOR THOSE WITH SOME COLLEGE EDUCATION OR COLLEGE DEGREES

| N = 564 | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.29259 | -1.57222 |
| Number of Dependents | .21057 | -.11831 |
| Age at End of Contract | .00713 | .25164 |
| Mid-Atlantic | .03526 | .16664 |
| Black | -.06210 | -.32519 |
| Other Race (Asian,etc) | -.25997 | -.91479 |
| West/North/Central | -.12223 | -.50028 |
| South-Atlantic | -.43541 | -2.15946** |
| East/South/Central | -.43968 | -1.53759 |
| West/South/Central | -.29937 | -1.02874 |
| Mountain Region | -.49228 | -1.47433 |
| Pacific Region | .21682 | .81406 |
| New England | -.21484 | -.73036 |
| Junior ROTC Experience | .19997 | .53668 |
| General Science | .00988 | .07653 |
| Word Knowledge | -.02508 | -.19734 |
| Math Knowledge | .01754 | .18586 |
| Mechanical Comp | -.03111 | -.30314 |
| Electronic Information | .16541 | 1.87082* |
| Paygrade | -.18734 | -1.47259 |
| Moral Waiver | .23194 | 1.63116 |
| Other Waiver | .02672 | .08598 |
| Admin Support MOS | -1.34572 | -4.97119** |
| Intelligence MOS | -.52847 | -1.19895 |
| Logistics MOS | -1.08003 | -3.26074** |
| Combat Support MOS | -.85795 | -3.00939** |
| Elec. Equip. Repair MOS | -.65440 | -2.46495** |
| Communications MOS | -1.00866 | -2.98833** |
| Aircraft Repair Ord. MOS | -.72099 | -2.56258** |
| Supply MOS | -1.38823 | -3.23808** |
| Mechanic MOS | -1.34475 | -3.56272** |
| Aircraft Operations MOS | -1.19431 | -3.62660** |
| Months in Delayed Entry | .00504 | .15078 |
| Summer Enlistee | -.19229 | -1.36065 |
| Number of Promotions | .03542 | .15150 |
| AFQTGI | -3.91184 | -.37818 |
| AFQTGII | -3.77466 | -.36502 |
| AFQTGIII | -3.701247 | -.35795 |
|  | INTERCEPT | INTERCEPT/SE |
|  | 10.84473 | 1.04485 |

PEARSON GOODNESS-OF-FIT CHI SQUARE=542.067 DF= 525 P=.294

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

investment soon, given they are older and have a shorter period over which to collect on their investment.

The factors which model human capital investment reacted similar to those in the non-high school graduate model. The key being that the math knowledge variable sign changed from negative to a positive effect on quitting. Given that mathematical skills and problem solving ability are more marketable than liberal arts type education, this result is not surprising. Again, AFQT group showed little variation between category I to III, with Category III having the smallest negative effect.

Finally, being a summer enlistee had a small negative effect on quits, and time spent in the delayed entry pool had no effect on the quit decision. The promotion factor also had no effect on quits.

This model correctly predicted 83.8 percent of all college graduates who quit.

## E. PREDICTIVE MODEL SELECTING ON AFQT-GROUP

In examining the results for the entire sample, model and subsamples selected on specific characteristics, it was shown that being in AFQT group I-IIIB had a significant effect on quits. The expectation existed that those in the highest mental category would be the most likely to quit. This was not always the case. Given this counterintuitive result the following models were analyzed selectring on each specific AFQT category.

### 1. AFQT Group I (Table 8)

The personal characteristic factors had a consistent negative effect on quits, given the individual is married. For this group the effect of marital status was nearly twice as large as that for the whole sample, Table 2. This result is significant in that it suggests significantly higher quitting costs for married Marines in mental group I. This might indicate a need for a policy shift in the Marine Corps, first to increase the welfare of the Marine family - thereby maintaining high quality Marines, and second, closing the compensation differential between single and married Marines. This policy shift would help to reduce the effect of marital status on the quit decision.

In this model for the first time the race variable for blacks is insignificant perhaps as a result of small sample size. However, the parameter estimate is negative and consistent with other models.

The education variables revealed negative parameter estimates for non-high school graduates, and those with some college, but were not significant. This negative effect on quits may be a result of credentialism in our socity. Even though these individuals are in the highest mental category, without the degree the available alternatives are limited.

Other factors of interest in this model were the effects of paygrade and having a waiver. First, the paygrade variable has revealed a consistently negative and

## TABLE 8

## PROBIT ESTIMATES OF PARAMETERS FOR THOSE IN AFQT GROUP I

| (N = 387) | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.79648 | -3.07598** |
| Number of Dependents | .15000 | .90009 |
| Age at End of Contract | .03088 | .70435 |
| Mid-Atlantic | .12016 | .47654 |
| Black | -.01463 | -.02290 |
| Other Race (Asian,etc) | .39335 | .80703 |
| West/North/Central | -.32829 | -1.15090 |
| South-Atlantic | .00011 | .00038 |
| East/South/Central | -.17025 | -.40350 |
| West/South/Central | -.27301 | -.66855 |
| Mountain Region | -.54692 | -1.42390 |
| Pacific Region | .01969 | .06586 |
| New England | -.35940 | -1.05252 |
| Non-High School Graduate | -.41892 | -.82260 |
| Some College Education | -.03329 | -.13194 |
| College Education | .07182 | .10011 |
| Junior ROTC Experience | .25789 | .48430 |
| General Science | -.36798 | -2.10126** |
| Word Knowledge | .08048 | .52615 |
| Math Knowledge | -.21411 | -1.25962 |
| Mechanical Comp | .15871 | 1.07979 |
| Electronic Information | .17222 | 1.29435 |
| Paygrade | -.49327 | -2.45876** |
| Moral Waiver | .22404 | 1.24025 |
| Other Waiver | -.99614 | 1.44082 |
| Admin Support MOS | -.88613 | -2.11507** |
| Intelligence MOS | -.28352 | -.58987 |
| Logistics MOS | -1.71929 | -4.19644** |
| Combat Support MOS | -1.20042 | -3.23431** |
| Elec. Equip. Repair MOS | -.67761 | -2.29348** |
| Communications MOS | -1.26888 | -3.16820** |
| Aircraft Repair Ord. MOS | -.35442 | -1.00699 |
| Supply MOS | -1.19422 | -2.42857** |
| Mechanic MOS | -.81805 | -1.44058 |
| Aircraft Operations MOS | -1.05810 | -2.99743** |
| Months in Delayed Entry | -.04867 | -1.64858 |
| Summer Enlistee | -.50515 | -2.57321** |
| Number of Promotions | .08218 | .30405 |
| | INTERCEPT | INTERCEPT/SE |
| | 9.92581 | 6.15087 |

PEARSON GOODNESS OF FIT CHI SQUARE=356.800 DF= 348 P=.361

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

significant effect on quits. Therefore, this factor is well established as a determinent of quit behavior. Second, the variables which take into account those granted waivers were positive but significant only at about the 20 percent level. Those who received waivers for other than disciplinary reasons had a negative effects on quits. This result though suspect due to its significance level may indicate that granting waivers to high mental group enlistees may not be a "good bet" in the long run, since the problems they had on entry may only become worse, encouraging a positive quit decision.

Finally, those factors which modeled job specific MOSs, time of entrance into the Marines, and promotions, resulted in similar effects on quits as explained in previous models. This model correctly predicted 82.8 precent of those who quit in mental group I.

### 2. AFQT Group II (Table 9)

Those in mental category II display results similar to the general population Table 2 and those in category III Table 10. It appears through examination of the parameter estimates that more factors become significant and negative in the change from category I to II and below.

In this model the personal characteristic variables, for marital status and race, result in significant and negative estimates, consistent with the general population. The

## TABLE 9

## PROBIT ESTIMATES OF PARAMETERS FOR AFQT GROUP II

| N = 4,482 | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.53249 | -8.27653** |
| Number of Dependents | .04561 | 1.15290 |
| Age at End of Contract | .02606 | -1.76536 |
| Mid-Atlantic | .09139 | 1.34024 |
| Black | -.40547 | -4.42557** |
| Other Race (Asian,etc) | -.19106 | -1.50900 |
| West/North/Central | .02978 | .37598 |
| South-Atlantic | -.01725 | -.24044 |
| East/South/Central | -.09717 | -.85640 |
| West/South/Central | -.08508 | -.86008 |
| Mountain Region | -.11210 | -1.10410 |
| Pacific Region | .20650 | 2.34161** |
| New England | .15544 | 1.54408 |
| Non-High School Graduate | .22025 | 1.37215 |
| Some College Education | .04209 | .44189 |
| College Education | .46544 | 1.51211 |
| Junior ROTC Experience | -.28498 | -1.66470 |
| General Science | -.00059 | -.01383 |
| Word Knowledge | -.06683 | -1.61273 |
| Math Knowledge | -.05569 | -1.77550 |
| Mechanical Comp | .03492 | .98672 |
| Electronic Information | .06691 | 2.25204** |
| Paygrade | -.33730 | -6.33655** |
| Moral Waiver | .06729 | 1.41245 |
| Other Waiver | .01879 | .13769 |
| Admin Support MOS | -1.08292 | -10.17488** |
| Intelligence MOS | -.63249 | -3.47776** |
| Logistics MOS | -.92023 | -7.26003** |
| Combat Support MOS | -.84727 | -8.30350** |
| Elec. Equip. Repair MOS | -.63031 | -6.83301** |
| Communications MOS | -.66409 | -5.83100** |
| Aircraft Repair Ord. MOS | -.87553 | -9.24390** |
| Supply MOS | -.87446 | -6.60564** |
| Mechanic MOS | -.83633 | -6.69488** |
| Aircraft Operations MOS | -.79923 | -6.70523** |
| Months in Delayed Entry | -.02068 | -2.68826** |
| Summer Enlistee | -.45991 | -8.42331** |
| Number of Promotions | .27035 | 3.14387** |
|  | INTERCEPT | INTERCEPT/SE |
|  | 9.37623 | 22.22476 |

PEARSON GOODNESS OF FIT CHI SQUARE=4394.026 DF= 4443 P=.697

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

regional variables of Pacific and New England result in positive effects on quits, but only the Pacific region variable was significant at the 5 percent level.

The education variables were not significant in this model. Note, however, that the estimate with the largest positive parameter estimate was those with college degrees, while the non-grads, and those with some college had a far smaller impact on quits. This result further supports the thesis that to obtain a high enough return on human capital to effect the quit decision a degree is needed.

Finally, this group's behavior with respect to specific MOSs is consistent with the general population. The variables are negative and significant at the 5 percent level. Those in the administrtive support have the highest negative effect on quits, and those in electronic equipment repair the smallest negative effect.

This model correctly predicted 95.5 percent of all those in mental category II who quit.

### 3. AFQT Group III (Table 10)

This model's estimates of personal characteristic variables coincide with those of the general model. Marital status and race have significant negative effects on quits. The regional variables for the Pacific and New England are again positive but not significant.

TABLE 10

PROBIT ESTIMATES OF PARAMETERS FOR AFQT GROUP III

| N = 6,541 | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.42563 | -8.17731** |
| Number of Dependents | -.01132 | -.36817 |
| Age at End of Contract | -.02053 | -1.56926 |
| Mid-Atlantic | -.03716 | -.65357 |
| Black | -.55645 | -11.05342** |
| Other Race (Asian,etc) | -.17118 | -1.97821 |
| West/North/Central | -.04466 | -.60764 |
| South-Atlantic | -.09422 | -1.69130 |
| East/South/Central | .07192 | .81841 |
| West/South/Central | -.05395 | -.68487 |
| Mountain Region | -.08441 | -.91249 |
| Pacific Region | .00917 | .12022 |
| New England | .06080 | .72531 |
| Non-High School Graduate | .16385 | 1.54018 |
| Some College Education | -.01169 | -.09605 |
| College Education | .67503 | 1.66251 |
| Junior ROTC Experience | -.03299 | -.26238 |
| General Science | .05276 | 1.61645 |
| Word Knowledge | -.10097 | -2.92783** |
| Math Knowledge | -.06862 | -2.93298** |
| Mechanical Comp | .01018 | .38239 |
| Electronic Information | .00224 | .09517 |
| Paygrade | -.47213 | -10.45212** |
| Moral Waiver | .09395 | 2.37859** |
| Other Waiver | -.02725 | -.29379 |
| Admin Support MOS | -1.02316 | -10.26586** |
| Intelligence MOS | -.84614 | -3.24606** |
| Logistics MOS | -.90229 | -7.70808** |
| Combat Support MOS | -.74822 | -9.04625** |
| Elec. Equip. Repair MOS | -.48143 | -5.85526** |
| Communications MOS | -.77187 | 8.40595** |
| Aircraft Repair Ord. MOS | -.83991 | -9.79907** |
| Supply MOS | -.80321 | -8.15142** |
| Mechanic MOS | -.85076 | -9.65585** |
| Aircraft Operations MOS | -.92900 | -6.87496** |
| Months in Delayed Entry | -.00281 | -.46965 |
| Summer Enlistee | -.45451 | -9.81386** |
| Number of Promotions | .17278 | 1.99046** |
|  | INTERCEPT | INTERCEPT/SE |
|  | 9.93189 | 27.79637 |

PEARSON GOODNESS OF FIT CHI SQUARE=6677.658 DF= 6502 P=.063

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

The education variable of some college was the only one which indicated a negative effect on quits. However, this factor is near zero and not significant. As anticipated not having a high-school degree had a positive effect on quits, and having a college degree had a large positive effect on quits. These results all support previous literature (Buddin, Ref. 11 and Blandin, Ref. 12) which indicate that those with high school degrees are the "best bet" given the Marines' goal to maintain quality people.

The variables for paygrade and job specific MOSs were all negative and significant at the 5 percent level. The administrative support and electrical equipment repair MOSs once again had the largest and smallest negative effects on quitting. The promotion variable was positive and significant at the 5 percent level. The overall effect of promotion on this group was about half that of the general population model.

This model correctly predicted 80.1 percent of all those in mental category III who quit.

### 4. AFQT Group IV and V (Table 11)

Those in mental category IV and V generally require a waiver to enter the Marine Corps. In this sub-sample there was no one with a college degree or in the intelligence MOS field. This group is the least recruited and quotas exist as to how many are allowed to enlist. As a matter of policy the Marine Corps needs to evaluate whether this group

TABLE 11

PROBIT ESTIMATES OF PARAMETERS FOR AFQT GROUPS IV AND V

| (N = 884) | REGRESSION COEFFICIENT | COEFFICIENT /S.E. |
|---|---|---|
| Marital Status | -.41898 | -2.70159** |
| Number of Dependents | -.01186 | -.13660 |
| Age at End of Contract | -.03416 | -.73723 |
| Mid-Atlantic | .26163 | 1.39530 |
| Black | -.70381 | -5.48893** |
| Other Race (Asian,etc) | .20790 | .69872 |
| West/North/Central | .00484 | .02037 |
| South-Atlantic | .04573 | .28036 |
| East/South/Central | -.02223 | -.10609 |
| West/South/Central | .27264 | 1.28139 |
| Mountain Region | -.35042 | -1.34420 |
| Pacific Region | -.11549 | -.44606 |
| New England | .47481 | 1.40245 |
| Non-High School Graduate | .53551 | .89445 |
| Some College Education | 3.40301 | .30500 |
| College Education | .00000 | .00000 |
| Junior ROTC Experience | -.14840 | -.61254 |
| General Science | -.09833 | -.90434 |
| Word Knowledge | .05724 | .58057 |
| Math Knowledge | -.15170 | -2.13070** |
| Mechanical Comp | .08141 | .90518 |
| Electronic Information | .00484 | .07079 |
| Paygrade | -.72607 | -5.51556** |
| Moral Waiver | .11776 | 1.02772 |
| Other Waiver | -.06136 | -.23565 |
| Admin Support MOS | -.76105 | -2.33640** |
| Intelligence MOS | .00000 | .00000 |
| Logistics MOS | -1.28429 | -3.59134** |
| Combat Support MOS | -.76790 | -3.12578** |
| Elec. Equip. Repair MOS | -.85356 | -3.42093** |
| Communications MOS | -.69007 | -2.76745** |
| Aircraft Repair Ord. MOS | -.65765 | -2.67339** |
| Supply MOS | -.59662 | -2.03134** |
| Mechanic MOS | -.92211 | -3.64181** |
| Aircraft Operations MOS | -.70650 | -1.90936* |
| Months in Delayed Entry | -.07844 | -3.94772** |
| Summer Enlistee | -.18432 | -1.14624 |
| Number of Promotions | .60931 | 2.38360** |
|  | INTERCEPT | INTERCEPT/SE |
|  | 11.66455 | 9.67575 |

PEARSON GOODNESS OF FIT CHI SQUARE=1684.642 DF= 847 P=4E-32

*SIGNIFICANT AT 10 PERCENT.
**SIGNIFICANT AT 5 PERCENT.

provides a sufficient substitute in quality and quantity to meet future manpower needs given the recent decline in the available population.

The model results show that with regards to personal characteristics this group behaves similarly to the general population. Differences occur in the education factor which have large positive effects on quits, as opposed to the high school graduate estimates. This model indicates that while in the short run those from this category (IV and V) may quickly fill recruiting quotas, their higher propensity to quit will lead to manpower shortfalls in the future.

Finally, with respect to job specific MOSs the "signs" and overall effect for this group were inconsistent with previous models. This result is most probably due to crowding of the lower mental category personnel into non-technical specialities. It is interesting to note that in this model the promotion variable had the largest positive effect on quits. This is difficult to explain since those with the most promotions would, in my opinion, have better and more rewarding alternatives available to them in the Marines. More research is necessary to determine what factors affect the promotions of categories IV's and V's, data which was not available for this thesis.

This model correctly predicted 94.7 percent of those in categories IV and V who quit.

# V. CONCLUSIONS

The most significant effects throughout the models were seen in the personal and job-specific characteristics. Being married had a significant and negative effect on quits in all models. It appears that this result is a function of the higher cost of quitting incurred by married Marines, who receive greater allowances for housing, an implicit larger benefit for family health care, and greater freedom in determining the mix of goods they desire to purchase with their housing and subsistance allowances. The next significant personal characteristic, being black, resulted in significant negative effects on quitting. This factor remained unchanged in "sign" and varied little regardless of education, marital status, education or AFQT group. This indicates that blacks, specifically, receive a higher utility from the compensation and benefits, both pecuniary and non-pecuniary received in the Marine Corps versus the civilian labor market. The results reflects the attitude of at least perceived discrimination in the civilian labor market, and provides evidence for the Marine Corps recovery from the racial strife which existed in the late 70's.

The job-specific characteristics were also stable and significant as indicators of quits in all models. The omitted factor was infantry, and in all other MOS's the overall effect on quits was negative and significant. Specifically, in the occupations considered more desirable, such as administrative support, logistics, and general mechanics there were large and significant negative effect on quits. As a result, these fields are typically overcrowded. The more technical jobs with good transferrability of skills to the civilian labor market had the smallest negative effect on quits. The electronic equipment repair and communications MOSs were smallest and as a result these fields suffer from manpower shortages.

In attempting to model education and ability on the probability of a quit resulted in findings supported by previous literature. That is, that high school graduates, from AFQT Groups II and III were the "best bet" for continuing to serve in the Marine Corps past their initial enlistment. Additionally, the variables for math knowledge and word knowledge from the ASVAB were significant, and had a very small negative effect on quits.

The charateristics modeling census region were disappointing. In most models only one or possibly two variables became significant at the 10 percent level. However, a consistency throughout the models existed for those from the Pacific and New England regions in that there was a positive effect on quits. A future study would want to approach these regional factors along with data on the economic environment to try to establish if certain regions tend to produce a Marine who will be more likely to quit.

If future study could be carried on from this point it is recommended that two approaches be taken. First, the analyst should attempt to obtain information on perceptual factors of Marine Corps life such as in the 1985 Department of Defense Survey of Military Personnel. By matching these files to the individuals' records, one may be better able to establish inferences between perceptions and actual behavior. Second, a more detailed analysis of quit behavior within specific occupational fields might be done to reduce any conflict that may arise because of the MOS grouping technique used in this thesis.

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